UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
PROGRAM PLANNING AND INTEGRATION
Silver Spring, Maryland 20910

MAY 26 2011

To All Interested Government Agencies and Public Groups:

Under the National Environmental Policy Act (NEPA), an environmental review has been performed on the following action.

TITLE: *Environmental Assessment on the Effects of the Issuance of a Scientific Research Permit (File No. 15677) to Conduct Scientific Research on Shortnose Sturgeon in South Carolina Rivers.*

LOCATION: Netting would take place within all major South Carolina river basins to the first impassible dam.

SUMMARY: The current EA analyzed the effects of shortnose sturgeon research on the environment within South Carolina river basins. Specifically, the Savannah, ACE Basin, including the Ashepoo, Combabee and Edisto Rivers, Cooper, and Santee Rivers, Lake Marion and its tributaries, and the Winyah Bay system, including the Black, Waccamaw, Sampit, Little Pee Dee and Great Pee Dee Rivers, would be surveyed with gill nets and trawls to the first impassible dam. If authorized, the applicant would also assess shortnose sturgeon usage of the upper Santee River Basin (Wateree, Saluda, and Congaree Rivers) as part of two Federal Energy Regulatory Commission (FERC) relicensing projects: the Duke Energy Catawba Wateree and the SCANA Services Saluda Hydroelectric Projects

The proposed action analyzed in the EA would not have significant environmental effects on the target or non-target species; public health and safety would not affected; no unique geographic area would be affected; and the effects of this study would not be highly uncertain, nor would they involve unique or unknown risks. Issuance of this permit would not set a precedent for future actions with significant effects, nor would it represent a decision in principle about a future consideration. There would not be individually insignificant but cumulatively significant impacts associated with the proposed action, and there would not be adverse effects on historic resources. The permit would contain mitigating measures to avoid unnecessary stress to the subject animals.

RESPONSIBLE OFFICIAL:

James H. Lecky
Director, Office of Protected Resources
National Marine Fisheries Service
1315 East-West Highway
Silver Spring, MD 20910
(301) 713-2332

The environmental review process led us to conclude this action will not have a significant effect on the human environment. Therefore, an environmental impact statement will not be prepared. A copy of the finding of no significant impact (FONSI) including the supporting EA is enclosed for your information.

Although NOAA is not soliciting comments on this completed EA/FONSI, we will consider any comments submitted assisting us to prepare future NEPA documents. Please submit any written comments to the responsible official named above.

Sincerely,

Paul N. Doremus, Ph.D.
NOAA NEPA Coordinator

Enclosure

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Silver Spring, MD 20910

MAY 26 2011

ENVIRONMENTAL ASSESSMENT
ON THE EFFECTS OF THE ISSUANCE OF A SCIENTIFIC RESEARCH PERMIT (File No. 15677) TO CONDUCT SCIENTIFIC RESEARCH ON SHORTNOSE STURGEON IN SOUTH CAROLINA RIVERS

Lead Agency: USDC, National Oceanic and Atmospheric Administration
National Marine Fisheries Service, Office of Protected Resources

Responsible Official: James H. Lecky, Director, Office of Protected Resources

For Further Information Contact: Office of Protected Resources
National Marine Fisheries Service
1315 East West Highway
Silver Spring, MD 20910
(301) 713-2289

Location: South Carolina rivers including the Savannah, ACE Basin (Ashepoo, Combahee, and Edisto Rivers), Cooper, Santee, Lake Marion and tributaries, and Winyah Bay System).

Abstract: The National Marine Fisheries Service (NMFS) proposes to issue a scientific research permit (File No. 15677) to the South Carolina Department of Natural Resources, Wildlife and Freshwater Fisheries Division (SCDNR) (William Post, PI: 217 Fort Johnson Road, Charleston, SC 29412), to take shortnose sturgeon (*Acipenser brevirostrum*) in the wild for purposes of scientific research pursuant to the Endangered Species Act of 1973, as amended (ESA; 16 U.S.C. 1531 *et seq.*).

The applicant is seeking a five-year scientific research permit assessing the presence, status, health, abundance, and distribution of shortnose sturgeon within South Carolina rivers basins (Savannah, ACE Basin, including the Ashepoo, Combabee and Edisto Rivers, Cooper, and Santee Rivers, Lake Marion and its tributaries, and the Winyah Bay system, including the Black, Waccamaw, Sampit, Little Pee Dee and Great Pee Dee Rivers), each to the first impassible dam. If authorized, the applicant would specifically assess shortnose sturgeon usage of the upper Santee River Basin (Wateree, Saluda, and Congaree Rivers) as part of two Federal Energy Regulatory Commission (FERC) relicensing projects: the Duke Energy Catawba Wateree and the SCANA Services Saluda Hydroelectric Projects.

The information gained about the presence, abundance and distribution of shortnose sturgeon in South Carolina would prove useful helping guide management efforts to identify, restore and protect critical habitats.

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CHAPTER 1 PURPOSE AND NEED FOR ACTION

1.1 DESCRIPTION OF ACTION

In response to a request from the SCDNR (William Post, PI: 217 Fort Johnson Road, Charleston, SC 29412), the National Marine Fisheries Service Office of Protected Resources (NMFS-PR) proposes to issue a scientific research permit (File No. 15677). The permit would authorize "takes"[1] of shortnose sturgeon in South Carolina rivers pursuant to the Endangered Species Act of 1973 (ESA; 16 U.S.C. 1531 *et seq*.) and the regulations governing the taking, importing, and exporting of endangered and threatened species (50 CFR Parts 222-226).

1.1.1 *Purpose and Need*:

The purpose of the aforementioned scientific research would be to gather information used to help inform conservation management decisions to recover shortnose sturgeon in the wild. Section 10(a)(1)(A) of the ESA allows NMFS to issue permits and permit modifications to take ESA-listed shortnose sturgeon. The applicant requires a new permit issued to conduct the proposed research.

The primary purpose of the permit, therefore, is to provide an exemption from the take prohibitions under the ESA to allow "takes" of shortnose sturgeon for bona fide scientific research. The need for issuance of the permit is related to NMFS's mandates under the ESA. Specifically, NMFS has a responsibility to implement the ESA to protect, conserve, and recover threatened and endangered species under its jurisdiction. The ESA prohibits takes of threatened and endangered species, respectively, with only a few very specific exceptions, including for scientific research and enhancement purposes. Permit issuance criteria require that research activities are consistent with the purposes and policies of these federal laws and will not have a significant adverse impact on the species.

1.1.2 *Objectives of the research*:

The applicant is seeking a five-year scientific research permit to assess presence, abundance, and distribution of shortnose sturgeon within South Carolina rivers (Savannah, ACE Basin, including the Ashepoo, Combabee and Edisto Rivers, Cooper, and Santee Rivers, Lake Marion and its tributaries, and the Winyah Bay system, including the Black, Waccamaw, Sampit, Little Pee Dee and Great Pee Dee Rivers).

1.2 OTHER EAs INFLUENCING THE SCOPE OF THIS EA

A number of EAs and SEAs have been prepared on the effects of similar proposed research techniques related to shortnose sturgeon. Appendix 1 lists recently issued NMFS permits or permit modifications for shortnose sturgeon for which EAs or SEAs were prepared. Each resulted in a Finding of No Significant Impact (FONSI) determination and has not been controversial. If the applicant's current application results in a permit being issued, it would replace an existing permit

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1 The ESA defines "take" as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct." The term "harm" is further defined by regulations (50 CFR §222.102) as "an act which actually kills or injures fish or wildlife. Such an act may include significant habitat modification or degradation which actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns including breeding, spawning, rearing, migrating, feeding, or sheltering."

(NMFS Permit 1505-01) expiring May 15, 2011, and would utilize similar methods and take authorizations studying shortnose sturgeon in South Carolina rivers.

The original EA for File 1505 was prepared together with Files 1489 and 1516 on May 4, 2006, entitled "*Environmental Assessment of the Issuance of Scientific Research Permit to Dr. James P. Kirk, U.S. Army Engineer Research and Development Center (File No. 1489), Mr. Douglas W. Cooke, South Carolina Department of Natural Resources (File No. 1505), and Mr. Thomas F. Savoy, Connecticut Department of Environmental Protection (File No. 1516).*" For File 1505, this EA evaluated the effects for non-lethal research capturing up to 98 adult and sub-adult shortnose sturgeon annually. Research measures included handling, weighing, measuring, anesthetizing, tagging, taking genetic tissue samples, implanting sonic transmitters, laparoscoping, lethal taking of eggs and authorizing two incidental mortalities of sturgeon annually.

On January 8, 2008, the Permit Holder was issued a minor modification (Permit Modification No.1505-01) replacing the existing Responsible Party/Principal Investigator as well as adding other Co-investigators. Also, in consultation, new more conservative conditions were introduced by NMFS PR1 lessening minor impacts on shortnose sturgeon. These revised conditions addressed the manner of taking proposed in the original permit, but did not alter the focus or action area, the timing, numbers, or methods of taking, nor did they include any other environmental impacts. As such, no new NEPA documentation was required for this modification.

In the original EA, there were two alternatives considered: (1) the Proposed Action alternative (*i.e.*, approving the authorizations requested and issuing the permit), and (2) the No Action alternative (*i.e.*, not approving the requested permit). The Proposed Action was in each case the preferred alternative. The No Action alternative was not preferred because the opportunity to collect information contributing to the better understanding of shortnose sturgeon and providing valuable information to NMFS would be lost. Further, each proposed action was found to help conserve, manage, and recover shortnose sturgeon as required by the ESA and implementing regulations.

Based on the best available information, a Finding of No Significant Impact (FONSI) was signed by the Assistant Administrator for Fisheries for the original action (File 1505) on May 15, 2006. It concluded the activities analyzed and the issuance of the permit would not significantly impact the quality of the human environment, including the target species, shortnose sturgeon, or any non-target species.

1.3 SCOPING SUMMARY

The purpose of scoping is identifying the issues to be addressed and the significant issues related to the proposed action, as well as identifying and eliminating from detailed study of the issues not significant or those previously covered by prior environmental review. An additional purpose of the scoping process is identifying the concerns of the affected public and Federal agencies, states, and Indian tribes. CEQ regulations implementing the National Environmental Policy Act of 1969 (NEPA; 42 U.S.C. 4321 *et seq.*) do not require a draft EA be made available for public comment as part of the scoping process.

A Notice of Receipt of the application was published in the Federal Register (November 30, 2010; 75 FR 74003) announcing the availability of the application for permit and related documents for public comments (File No 15677). However, no comments were received from the public regarding this application. Comments from NMFS Southeast Regional Office were also solicited and appropriately addressed within the EA and decision memos with respect to how the permit would authorize standard, well known and non-controversial research techniques.

1.4 APPLICABLE LAWS AND NECESSARY FEDERAL PERMITS, LICENSES, AND ENTITLEMENTS

This section summarizes federal, state, and local permits, licenses, approvals, and consultation requirements necessary to implement the proposed action, as well as who is responsible for obtaining them. Even when it is the applicant's responsibility to obtain such permissions, NMFS is obligated under NEPA to ascertain whether the applicant is seeking other federal, state, or local approvals for their action.

1.4.1 *National Environmental Policy Act*:

The National Environmental Policy Act (NEPA) was enacted in 1969 and is applicable to all "major" federal actions significantly affecting the quality of the human environment. A major federal action is an activity fully or partially funded, regulated, conducted, or approved by a federal agency. NMFS issuance of permits for research represents approval and regulation of activities. While NEPA does not dictate substantive requirements for permits, licenses, etc., it requires consideration of environmental issues in federal agency planning and decision making. The procedural provisions outlining federal agency responsibilities under NEPA are provided in the Council on Environmental Quality's implementing regulations (40 CFR Parts 1500-1508).

NMFS, through NOAA Administrative Order (NAO) 216-6, follows agency procedures for complying with NEPA and the implementing regulations issued by the Council on Environmental Quality. NAO 216-6 specifies issuing scientific research permits under the MMPA and ESA is among a category of actions generally exempted (categorically excluded) from further environmental review, except under extraordinary circumstances. When a proposed action, otherwise categorically excluded, is (1) the subject of public controversy based on potential environmental consequences; (2) has uncertain environmental impacts or unknown risks; (3) establishes a precedent or decision in principle about future proposals, may result in cumulatively significant impacts; or (4) may have an adverse effect upon endangered or threatened species or their habitats, preparation of an Environmental Assessment (EA) or Environmental Impact Statement (EIS) is required.

While issuance of scientific research permits is typically subject to a categorical exclusion, as described in NAO 216-6, NMFS is preparing an EA for this action providing a more detailed analysis of effects to ESA-listed species. This EA therefore is prepared in accordance with NEPA, its implementing regulations, and NAO 216-6.

1.4.2 *Endangered Species Act*:

Section 9 of the ESA, as amended, and Federal regulations pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without special exemption such as by a permit. Permits to take ESA-listed species for scientific purposes, or for the purpose of enhancing the propagation or survival of the species, may be granted pursuant to section 10(a)(1)(A) of the ESA.

NMFS has promulgated regulations to implement the permit provisions of the ESA (50 CFR Part 222) and has produced OMB-approved application instructions prescribing the procedures necessary to apply for permits. All applicants must comply with these regulations and application instructions in addition to the provisions of the ESA.
Section 10(d) of the ESA stipulates for NMFS to issue permits under section 10(a)(1)(A) of the ESA, the Agency must find that the permit: was applied for in good faith; if granted and exercised will not operate to the disadvantage of the species; and will be consistent with the purposes and policy set forth in section 2 of the ESA.

Section 2 of the ESA sets forth the purposes and policy of the Act. The purposes of the ESA are to provide a means whereby the ecosystems upon which endangered and threatened species depend may be conserved, to provide a program for the conservation of such endangered species and threatened species, and to take such steps as may be appropriate to achieve the purposes of the treaties and conventions set forth in section 2(a) of the ESA. It is the policy of the ESA that all Federal departments and agencies shall seek to conserve endangered species and threatened species and shall utilize their authorities in furtherance of the purposes of the ESA. In consideration of the ESA's definition of conserve, which indicates an ultimate goal of bringing a species to the point where listing under the ESA is no longer necessary for its continued existence (i.e., the species is recovered), exemption permits issued pursuant to section 10 of the ESA are for activities that are likely to further the conservation of the affected species.

Section 7 of the ESA also requires consultation with the appropriate federal agency (either NMFS or the U.S. Fish and Wildlife Service, (USFWS)) for federal actions that "may affect" a listed species (USFWS 2009) or adversely modify critical habitat. NMFS' issuance of a permit affecting ESA-listed species or designated critical habitat, directly or indirectly, is a federal action subject to these section 7 consultation requirements. Section 7 requires federal agencies to use their authorities in furtherance of the purposes of the ESA by carrying out programs for the conservation of endangered and threatened species. NMFS is further required to ensure any action it authorizes, funds, or carries out is not likely to jeopardize the continued existence of any threatened or endangered species or result in destruction or adverse modification of habitat for such species. Regulations specify the procedural requirements for these consultations (50 Part CFR 402).

1.4.3 *Magnuson-Stevens Fishery Conservation and Management Act*

Section 305(b)(2) of the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA) requires NMFS to complete an Essential Fish Habitat (EFH) consultation for any action authorized, funded, or undertaken, or proposed to be authorized, funded, or undertaken by the agency that may adversely affect EFH.

CHAPTER 2: ALTERNATIVES INCLUDING THE PROPOSED ACTION

This chapter describes the range of potential actions (alternatives) determined reasonable with respect to achieving the stated objectives. The expected outputs and any related mitigation of each alternative is also included. Alternative Number 1 is the "No Action" alternative where the proposed permit would not be issued. The No Action alternative is the baseline for the rest of the analyses.

Alternative No. 2 is the "Proposed Action" alternative representing the research proposed in the submitted application for a permit, with standard permit terms and conditions specified by NMFS.

2.1 ALTERNATIVE No. 1: NO ACTION

Under this alternative, the No Action alternative, the scientific research permit (File No. 15677) authorizing capturing shortnose sturgeon with gill nets trammel nets and trawls, measuring, weighing, tagging with passive integrated transponders (PIT), dart, and sonic tags, anesthetizing, laparoscoping, and taking genetic tissue samples, tissue biopsies and blood samples, would not be issued.

2.2 ALTERNATIVE No. 2: PROPOSED ACTION –ISSUANCE OF PERMIT WITH STANDARD CONDITIONS

Under this alternative, the Proposed Action alternative, a five-year permit from the date of issuance would be issued for research activities, the permit terms and conditions standard to such permits as issued by NMFS. The permit would authorize non-lethal sampling with anchored gillnets, trammel nets and trawls, capturing up to 154 shortnose sturgeon adults and sub-adults annually from the Savannah, ACE Basin, Cooper, Santee Rivers, Winyah Bay System, and Lake Marion and its tributaries. Sturgeon taken in good condition would be measured, weighed, sampled for genetic tissue analysis, and PIT and dart tagged. Additionally, up to 110 sturgeon would be anesthetized and implanted with internal sonic transmitters annually. Sturgeon sex and general health would be determined from a sample of 24 fish annually from the Cooper River using laparoscopy, and if necessary to confirm sex, biopsies of gonad material would be taken. Afterward, blood samples would be collected and processed determining endocrine disrupters. Manual tracking and passive detections of telemetered fish at fixed receiver stations would provide information about movements and habitat use. Recaptures of tagged fish would also be used to estimate abundance when appropriate. Additionally, lethal collection of up to 50 eggs and larvae from both the Savannah River and Lake Marion and its tributaries would take place during seasonal spawning activity using artificial substrates. Finally, up to 20 young of year (YOY) and other juveniles less than 300 mm would be sampled with epibenthic trawls in Lake Marion and its tributaries, and in the Savannah, ACE Basin, Cooper, Santee, and Winyah Bay System. No annual unintended sturgeon mortality or serious harm resulting from research would be authorized.

2.3 DESCRIPTION OF THE PROPOSED ACTION

2.3.1 *Boundaries of Action Area*:

The action area is defined in 50 CFR 402.02 as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action." The description of the action area therefore includes the areas affected by sampling activities as well as the area transited by project vessels.

The SCDNR seeks authorization to sample and track endangered shortnose sturgeon in river systems throughout the state of South Carolina (See Figure 1 and 2 below) including: Savannah River; ACE Basin (including the Ashepoo, the Combahee and the Edisto Rivers); Cooper River; Santee River, Lake Marion and its tributaries (including the Saluda River, Broad River, Congaree River and Wateree River) and the Winyah Bay watershed (including the Black, Waccamaw, Sampit, Little Pee Dee and Great Pee Dee Rivers). The study area in the upper Santee Basin in the Wateree, Congaree and Saluda Rivers is in association with two FERC relicensing projects: the Duke Energy Catawba-Wateree and the SCANA Services Saluda Hydroelectric Projects. Netting activities with anchored and drift gill nets, trammel nets and trawls would be carried out in rivers between the fresh and saltwater interface and up to river kilometer 200, or up to the first impassable dam (Figure 1). Research vessels would also pass through and over the water column while transiting to collect telemetry data from receivers.

2.3.2 *Map of Action Area*:

The map of the action area is highlighted in Figure 1 and 2 below and is also illustrated online at: http://maps.google.com/maps/ms?ie=UTF8&hl=en&msa=0&msid=113286167511014551758.00048f4724bacf8629924&ll=32.852678,-80.19702&spn=1.68432,2.469177&t=h&z=9

Figure 1: Map of South Carolina Rivers and proposed gill netting and trawling locations.

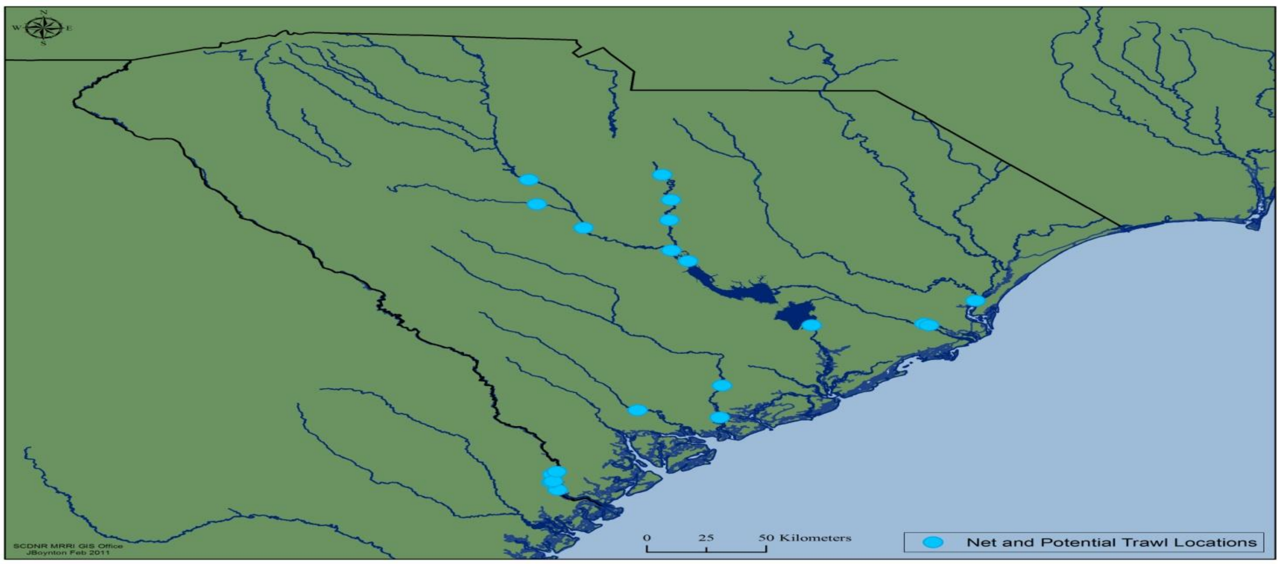
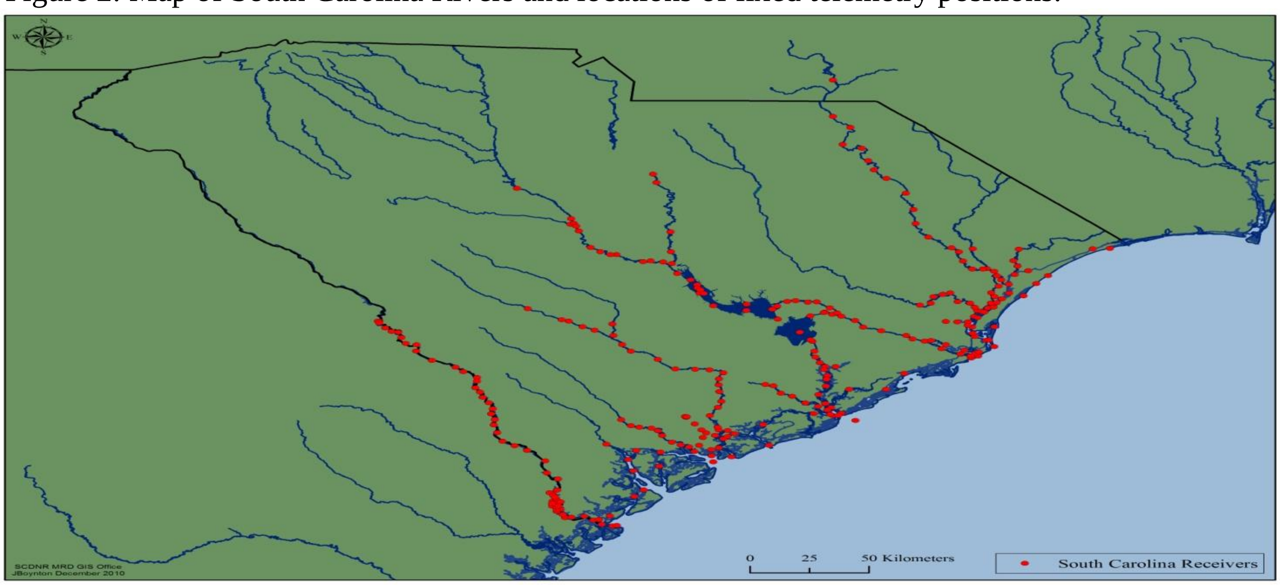


Figure 2: Map of South Carolina Rivers and locations of fixed telemetry positions.



2.3.3 *Research Goals and Proposed Activities*:

The purpose of research would be to determine the presence, status, health, abundance, distribution and movements of shortnose sturgeon in South Carolina waters (Savannah, ACE Basin, Cooper, and Santee Rivers and Lake Marion and its tributaries, and Winyah Bay System). Recovery goals outlined within the Shortnose Sturgeon Recovery Plan (NMFS 1998) *to survey for shortnose sturgeon in rivers where they have historically occurred* (*Rec. Goal No.1.1.4*); and *to conduct mark-recapture, telemetry, survey sampling, documenting seasonal distribution and mapping concentration areas to characterize essential habitat of shortnose sturgeon* (*Rec. Goal No. 1,2A**) have been attempted but not yet completed in South Carolina. Prior river specific surveys have only provided snapshots of shortnose sturgeon behavior in South Carolina. By increasing the coverage area, migration patterns and inter-basin transfer can be delineated. Field work activities would include deployment and maintenance of data-logging hydrophones; gillnetting (anchored and drift) trammel netting, and trawling to capture shortnose and Atlantic sturgeon; tagging including PIT tagging, dart tagging and surgical implanting VEMCO acoustic tags under anesthesia; tissue sampling (blood, genetic, and gonad biopsy), laparoscopy (associated with sex determination and health examination) and egg collection during spawning season.

The goals of the telemetry study would involve gaining a better understanding of riverine and near coastal movements of shortnose sturgeon on a South Carolina "big picture" basis. Presently, shortnose sturgeon movements are monitored largely by river-specific studies. This study aims to augment coverage areas identifying life history data gaps by deploying a series of acoustic hydrophone receivers in major river systems surveyed. Approximately 60 receivers per river system would be placed between the mouth (near coastal) river kilometer (RKM) 0 and potential sites where spawning occurs or to the first major dam. For smaller river systems, remaining receivers will be positioned in the neighboring sounds, Intracoastal Waterway (ICW), or used in larger river systems where shortages occur. Plans also include annually telemetry tagging with acoustic transmitters up to 110 adult/sub-adult shortnose sturgeon in all of the sampling areas (Savannah, ACE Basin, including the Ashepoo, Cooper, and Santee rivers and the Lake Marion and its tributaries and the Winyah Bay System). Receivers would be downloaded and data would be shared between states and also stored in a central data base.

Sampling along coastal rivers would focus on capturing adults and juveniles during summer when sturgeon would most likely be congregated in deepwater areas (holes) located near the fresh-saltwater interface (approximately 20 to 30 kilometers from mouths of rivers). However, other sampling would be conducted at likely staging areas between late winter and early spring before the beginning of spring spawning runs. Trawling for juveniles and YOY would take place in habitat suitable for juvenile nursery. If viable populations of shortnose sturgeon could be identified in any of the South Carolina rivers, telemetry tagging of sub-adults or adults would enable monitoring temporal and spatial movement patterns helping identify critical habitat for any discovered populations. Abundance estimates would also be conducted if sufficient numbers of captured sturgeon in rivers warranted such estimates.

Additional research components would include surveys directed for developing two hydro relicensing fishway prescriptions requiring a research period prior to the consideration of any fish passage facilities on the Lake Murray Dam (SCANA Services) and on the Lake Wateree Dam (Duke Energy Company). To inform this effort, the applicant would be surveying sturgeon usage below each of these projects in the Saluda, Congaree, and Wateree Rivers in the Santee River Basin (See Fig 1 and 2).

Finally, a smaller research component would include efforts to develop and validate an alternative genetic-based aging technique whereby telomere genetic material collected in the study, and archived elsewhere, would be evaluated. Currently, the only accepted aging technique for shortnose sturgeon involves aging pectoral fin spines sections. However, development of standard age curves for shortnose sturgeon using telomere length would be attempted using known-age samples to test the reliability of the curve in age prediction.

2.3.4 *Proposed Take Summary*:

The applicant proposes sampling with anchored and drift gillnets, trammel nets and trawls, capturing up to 154 shortnose sturgeon adults and/or juveniles annually from the Savannah, ACE Basin, Cooper, Santee Rivers Winyah Bay System, and Lake Marion and its tributaries. Those taken in good condition would be measured, weighed, sampled for genetic tissue analysis, and PIT and dart tagged. Additionally, up to 110 shortnose sturgeon from the Savannah, ACE Basin, Cooper, Santee Rivers Winyah Bay watershed, and Lake Marion and its tributaries would be anesthetized, and implanted with internal sonic transmitters. Manual tracking and passive detections of telemetered fish at fixed receiver stations would provide information about movements and habitat use. Sturgeon sex would be determined from a sample of 24 fish annually from the Cooper River by performing laparoscopy and/or biopsy (inserting a laparoscope in the body cavity to sample gonad material). After sex determination, blood samples would be collected from each fish and processed in an effort at determining endocrine disrupters. Additionally, lethal collection of up to 50 eggs and larvae from both the Savannah River and Lake Marion (and tributaries) would take place during seasonal spawning activity by artificial substrate. Lastly up to 20 YOY would be sampled using an epibenthic trawl in Lake Marion (and tributaries), Savannah, ACE Basin, Cooper, Santee, and Winyah Bay system. No unintended sturgeon mortality or serious harm resulting from research would be authorized. A table of the proposed take is summarized in Appendix 2.

2.3.4.1 *Capturing*:

All necessary precautions would be taken to ensure shortnose sturgeons are not harmed during capture and handling. Adult/juvenile fish would be captured using a standardized netting protocol (anchored and drift gill or trammel nets) approximately 1-3 days per week throughout the duration of the study. No surgical procedures would take place below 7°C or above 27°C. That is, if exceeding these limits, once measured, weighed, photographed, PIT and dart tagged and genetic tissue sampled, sturgeon would be recovered and released as soon as possible. In addition, YOY would be targeted using a "balloon" trawl net to assess recruitment.

- *Anchored Gill and Trammel Netting*: Gill nets of 12.7 cm (5-inch) or trammel nets with inner mesh of 8.89 cm (3.5-inch) stretched mesh and outer mesh of 38.1 cm (15 inch) would be used to sample adult shortnose sturgeon. Nets would typically measure 92 m long by 1.8 m deep, although shorter nets may sometimes be used depending on areas used. Netting activity would cease in waters below 0 ºC and above 28ºC, and gill nets would be required to be constantly monitored with one exception: overnight sets for up to 14 hours would be allowed used unattended in the Edisto River above river mile 40; however, to avoid interactions with Florida manatee, nets could only be set between November and March and in water temperatures between 0 and 15ºC. At all other locations, when temperatures are between 0 and 15ºC, nets must be attended during daylight hours only for up to 10 hours. In water with temperatures between 15ºC and 20°C, net sets would not exceed 4 hours; at temperatures between 20ºC and 25ºC soak times would not exceed 2 hours; and at temperatures between 25ºC and 28ºC net sets would not exceed 1 hour. Additionally, all netting would occur in waters having minimum dissolved oxygen (D.O.) concentrations of 4.0 mg/L during deployment. (See Table 1 below)

Table 1: Summary of general netting conditions (all net sets must be attended in daylight hours except where noted below)

Water Temperature (ºC)	Minimum D.O. Level (mg/L)	Maximum Net Set Duration (hr)
0 ≤ 15	4.0	14[1]
0 ≤ 15	4.0	10
15 ≤ 20	4.0	4
20 ≤ 25	4.0	2
25 ≤ 28	4.0	1
>28	N.A.	Cease Netting

1. Unattended overnight net set durations of up to 14 hours are allowed on the Edisto River (RM≥40) between November and March and also when water temperatures are between 0 and 15ºC.

- *Drift Gill Netting*: The applicant proposes to use drift gill nets drifting on the rising tide or in slack tide until just after high tide for durations of approximately thirty minutes to approximately two hours, depending on the location and swiftness of the tide. Water quality conditions for drift nets would be the same as for anchored gillnets; however, all drift net sets would be continuously tended because of the risk of gear entanglement or loss of gear resulting in ghost nets. Fishing gear would be pulled immediately if it were obvious a sturgeon has been captured.

Drift gillnets would be set and marked with GPS coordinates during early stage flood tide (slack) perpendicular to the tidal current and tended closely by researchers until high tide. To maximize chances of catching sturgeon, 92-meter nets would be configured to make contact with the bottom and would have smaller mesh on the bottom two meters (McCord et al. 2007). Flat bottom locations free of snags near the freshwater-brackish water interface would be preferred for each drift set.

- *Trawling*: Because smaller juvenile and YOY sturgeon age groups are not easily targeted with gill nets and other gear used for sturgeon research, the applicant proposes to use a modified balloon trawl referred to as a Missouri Trawl (Herzog et al. 2005) annually capturing up to 20 YOY in South Carolina Rivers. Fish smaller than 300 mm would not be tagged, but would be measured, weighed, and photographed before returned to the water unharmed. The Missouri Trawl proposed is a two-seam (i.e., standard) slingshot balloon trawl (Gutreuter et al., 1995) and is completely covered with 0.375-in heavy, delta-style mesh. The width of the trawl narrows from 16 feet at the headrope to 3feet at the mid-section to 1.25 feet at the cod (distal) end. The footrope of the trawl is 18 feet long, and a 0.375inches diameter chain attached to it which helps the footrope maintain contact with the substrate during conditions of heavy current, fast tow speeds, or undulating bottom surfaces (e.g., sand waves). A standard haul would be approximately 300 to 500 feet lasting approximately 10 to 15 minutes (Gutreuter et al., 1995). Trawling speed would vary between 3 to 5 miles per hour and the location of trawling would be monitored with a Garmin/Global Positioning System preventing trawling over the same bottom area in a 24-hour period.

- *Egg/Larvae Collection with Egg Mats*: The applicant proposes to collect and preserve up to 50 sturgeon eggs annually from both the Savannah River and Lake Marion (and its tributaries) during the spring spawning runs of sturgeon with the objective of confirming the timing and scope of spawning activity. To locate shortnose sturgeon spawning sites 22 inch circular buffer pads would deployed in locations near spawning grounds to passively collect eggs drifting in the water. The pads would be secured with concrete weights, marked with a float and retrieved and checked for eggs every 48 to 72 hours. Eggs collected at each site would be preserved in a buffered formalin solution for later identification and verification of the spawning time.

2.3.4.2 General Handling (e.g., Holding, Measuring, Weighing):

To minimize stress during capture and handling, all shortnose sturgeon would removed from capture gear and recovered within 200 cm long x 150 cm wide x 200 cm deep boat-side net pens until. Sturgeon would be further processed onboard where they would be transferred by hand to onboard live wells containing slime coat restorative. If increased catches occur, additional net pens would be employed to accommodate excess holding of sturgeon and bycatch. During processing, each fish would be immersed in a continuous stream of water supplied by a pump/hose assembly mounted to over the side of the research vessel and treated with a slime coat restorative. Dissolved oxygen would be supplemented with compressed oxygen to ensure D.O. concentrations do not fall below saturation. While onboard, sturgeon species would be first confirmed by a qualified biologist as they are measured, weighed, photographed. Fish identified as not previously captured, would receive a unique identifying PIT and dart tag and genetically tissue sampled. The time taken for these procedures would be approximately 2 to 3 minutes. Following this processing, fish will be returned to the net pens to ensure full recovery prior to release, except those adults (see below) selected to receive telemetry tagging, blood sampling or laparoscopy. Prior to being released, any fish not responding readily would be recovered further in the net pen by holding the fish upright and immersed in river water and gently moving the fish front to back to aid freshwater passage over the gills to stimulate the fish. When showing signs of being able to swim away strongly, the fish would be released with a spotter watching to make sure the fish stays down and is fully recovered. The total holding time of fish processed in the above manner would be variable depending on water temperature and the condition of each fish, however no fish would be held longer than 30 minutes from the time of capture until the time it is released, unless it had not recovered from netting stress.

2.3.4.3 Genetic Tissue Sampling:

- Soft Fin Tissues: Genetic information would be obtained from tissue samples of sturgeon helping characterize the genetic "uniqueness" and current level of genetic diversity of South Carolina populations. During processing, a small (1.0 cm^2) soft tissue sample would be collected from the trailing margin of soft tissue of one of the pectoral fins using sharp sterilized scissors and would be preserved in individually labeled vials containing 95% ethanol. The researcher has agreed to provide genetic tissue samples collected from shortnose sturgeon for archival purposes to NOAA/NOS in Charleston, South Carolina, and to Co-investigators identified in the permit. Proper certification, identity, and chain of custody of samples would be maintained during transfer of tissue samples.

- Telomere Aging: Development and testing of a telomere length aging technique would utilize previously collected tissue samples and would take place within a laboratory or office setting. Approximately 200 shortnose sturgeon tissue samples of known age individuals are already compiled from past SCDNR sturgeon studies (Collins et al. 2009) and available for the development of the aging tools. Other samples archived from past cooperative research projects along the Southeast U.S. Coast would also be a source of additional samples for this project, including larval through adult senescent stages for each species. One hundred animals would be used to test whether telomere length can be used to age these species. Initial analysis of telomere length would be performed using TeloTAGGG Telomere Length Assay kits (Roche Applied Science; Mannheim, Germany) following the manufacturers specifications. Following the development of the standard age curve for the species, an additional twenty known-age samples would be used to test the reliability of the data curve to aid in age prediction.

2.3.4.4 PIT Tagging:

Prior to PIT tagging, the entire dorsal surface of captured sturgeon would be scanned using a PIT tag reader to detect PIT tags of previously captured fish. All unmarked shortnose sturgeon (≥300 mm TL) would be tagged using 11.9 mm x 2.1 mm PIT tags injected using a 12 gauge needle at an angle of 60 to 80° in the dorsal musculature (left and just anterior to the dorsal fin). No fish would be double-tagged with PIT tags. The last step after injecting PIT tags would be to verify and record the PIT tag code with a tag reader. During the study, the rate of PIT tag retention would be documented and reported to NMFS in annual reports.

2.3.4.5 Dart Tagging:

The researcher proposes to externally tag shortnose sturgeon with dart tags in an effort to incorporate incidental recaptures by commercial or recreational fishermen and other researchers to make possible collection of information useful for the assessment of the sturgeon population. In all captured shortnose sturgeon, dart tags would be anchored in the dorsal fin musculature base and inserted forwardly and slightly downward from the left side to the right through the dorsal pterygiophores. After removing the injecting needle, the tag would be spun between the fingers and gently tugged to be certain the tag is locked in place. During the study, the rate of dart tag retention would be documented and reported to NMFS in annual reports.

2.3.4.6 Implanting Acoustic Transmitters:

A maximum of 20 adults (> 560 mm) and juvenile (300-560 mm) shortnose sturgeon annually are requested to be internally acoustically tagged from each river and Lake Marion (total of 110 annually). The total weight of tags would not exceed 2 percent of the fish's total body weight. Thus, dependent upon the weight of individual fish, sturgeon would be tagged with VEMCO V7-4L; V9-6L; V13-1H; or V16-5H tags. Specifications for these transmitters are listed in Table 2 below.

Table 2: Proposed Vemco acoustic tag models and specifications

Model	Length	Diameter	Weight (H^20)	Weight (O^2)
V7-4L	22.5 mm	7 mm	1.0 g	1.8 g
V9-6L	21.0 mm	9 mm	1.6 g	2.9 g
V13-1H	36.0 mm	13 mm	6.0 g	11.0 g
V16-5H	95.0 mm	16 mm	16.0g	36.0 g

- *Surgery for Implanting Acoustic Tags*: The following 4 to 6 minute transmitter implantation surgery under anesthesia would be used. No surgery above 27°C or below 7°C would take place. Just prior to the procedure, the candidate sturgeon would be removed from an anesthetic bath (described below) and placed on a moist surgery rack. A tube supplying fresh water over the gills would be placed in the mouth of the fish maintaining respiration. The incision site for implanting the tag (40 to 60 mm anterior to the pelvic fins, although the specific location would vary with fish size) would be disinfected with a 10 percent iodine solution. A sterile surgical packet containing all surgical instruments and supplies would be used to make a 10 mm incision. A sterilized sonic transmitter (manufactured with an inert polymer compound) would be inserted into the surgical openings of sturgeon and the incision closed with uninterrupted suturing and treated with iodine to help prevent infection. Post-surgery fish would be held in an aerated holding tank and/or released into the net pen for recovery. The applicant estimated the surgical procedure and total holding time to be no more than 20 minutes (including typical anesthesia induction, surgery and recovery). Further, internal tags would not be implanted in unhealthy or stressed fish or pre-spawning fish in the spring.

- *Light Anesthesia for Implanting Acoustic Tags*: Shortnose sturgeon selected for transmitter implantation, would be netted at temperatures 27ºC or below and 7ºC or above. Each sturgeon prepared for surgery would be anaesthetized using a bath solution of up to 150 mg/L of tricaine methane sulfonate (MS-222) buffered to neutral pH with sodium bicarbonate. Upon reaching a sedated anesthesia stage (i.e., slow movement and reduced breathing) animals would be removed from the solution and placed on a surgery rack to implant the tag. The anesthetic's induction and surgery would vary between 5 and 8 minutes, but would be appropriate for shortnose sturgeon under the specific water temperature and oxygen conditions present (Fox *et al*. 2000).

2.3.4.7 Laparoscopic Examination, Gonad Biopsy and Blood Collection of Adults: A variety of waterborne pollutants have been linked to adverse health or reproductive changes in fish, including altered gonadal development, changes in hormone concentrations, and production of female-specific proteins (e.g., vitellogenin) in male fish. The current health and reproductive status of shortnose sturgeon and level of estrogenic activity of pollutants in the tributaries they occupy are unknown. Mark Matsche, a CI on the applicant's previous permit (NMFS, Permit No. 1505) and the proposed permit, would analyze blood samples in the lab for testosterone, estradiol, vitellogenin and hematological ranges.

- *Laparoscopic Surgery*: Laparoscopic examinations have been used extensively in fisheries research (Murray, *et al.* 1998; Moccia *et al*. 1984; Ortenberger *et al*. 1996; and Stoskopf 1993) and refined for sturgeon work by Hernandez-Divers *et al*. (2004). Minimally invasive procedures (such as examining internal organs, determining sex, and performing biopsies) have been used by members of the researcher's staff on for the past four years (Permit No. 1505). The applicant now proposes to continue these same techniques with laparoscopic instruments determining the sex and reproductive health and taking gonad biopsies of 24 adult shortnose sturgeon captured annually from the Cooper River.

Using sterile technique, a small (~5 mm) incision would be made in the ventral body wall slightly off midline at a level midway between the pectoral girdle and the cloaca through which a 5-mm trocar would be inserted. A 5 mm rigid laparoscope would then be inserted through the trocar to allow visualization of gonads to determine sex and reproductive health of the animal. If necessary, the body cavity would be insufflated with ambient air by attaching a battery-powered air pump to the insufflation port of the trocar increasing the working space within the body cavity. For each animal, a modified version of a quantitative health assessment index for rapid evaluation of fish (Adams *et al*. 1993) would be made in a standardized fashion so results could be compared between individuals. Determination of the sex and reproductive status of the animal would be made and recorded. In those instances where the sex of the animal is not readily apparent, a biopsy of the gonad would be taken.

- *Biopsy Procedure*: Used in conjunction with laparoscopic surgery, a biopsy of gonadal tissue would be performed by making a second incision midway between the first laparoscopic incision and the pectoral girdle on the lateral aspect of the body approximately 1 cm dorsal to the ventral scutes. A second 5 mm trocar would then be inserted through the new incision, followed by a laparoscopic biopsy instrument to perform the biopsy. The sample would be approximately 5 mm in size (2-3g sample) and would be placed in 10% neutral, buffered formalin for preservation. Upon completion of the biopsy, the body cavity and biopsy site would be visually assessed ensuring no hemorrhaged tissue would require additional attention. The laparoscope and the two trocars would then be removed and the incisions would be closed using a single suture in a cruciate pattern.

- *Anesthesia for Laparoscopic Surgery*: The anesthesia with laparoscopy would be rapidly induced using a buffered solution of 250 mg/L MS-222 followed by a maintenance dose of 87.5 mg/L MS-222. Each animal chosen for examination (up to 24 proposed annually from the Cooper River) would be selected in excellent, non-stressed condition when netted. When removed from the net, each fish would be transported to a near-by field laboratory (two to three minute transport) providing a 110-v electrical outlet to operate the lab and surgical equipment. Upon arrival, the animal would be anesthetized with a 250 mg/L solution of buffered MS-222, fitted with a heart rate monitor assisting researchers determining when a state of surgical anesthesia has been reached, the point when the fish exhibits complete loss of equilibrium, decreased muscle tone and reaction to massive stimulation, while maintaining a depressed ventilation rate and a regular heart rate (Ross and Ross 1999; Summerfelt and Smith 1990, and Kahn and Mohead 2010). Just prior to the procedure, the animal would be positioned in lateral recumbence within a recirculating anesthesia machine delivering a maintenance dose of 87.5 mg/L buffered tricaine over the fish's gills. The time required to reach the proper stage of anesthesia would average 2 to 7 minutes (Matsche; unpublished data).

- *Blood Collection*: Blood would be collected from the caudal veins of 24 shortnose sturgeon adults annually to ascertain if estrogenic compounds might be adversely affecting the shortnose sturgeon population. This would be achieved by inserting a hypodermic needle perpendicular to the ventral midline at a point immediately caudal to the anal fin. The needle would be slowly advanced while applying gentle negative pressure with the syringe until blood freely flows into the syringe. Once a blood sample is collected, direct pressure would be applied to the site of to ensure clotting and prevent further blood loss (Stoskopf 1993). Needle and syringe size, as well as blood volume collected, would be dependent on the fish size, as presented below in Table 3.

Table 3: Needle and syringe sizes proposed based on fish weight

Weight (gr)	Sample Size (ml.)	Needle Size (Gauge x Length)	Syringe Size (ml.)
$\leq$ 1000	2	22g x 5/8”	3
1000 - 2000	3	22g x 5/8”	3
> 2000	6	20g x 1”	6

Each blood sample would be divided equally between two tubes, one tube containing the anti-coagulant lithium heparin and one tube containing none. Blood samples would then be centrifuged and placed in a cool dry place until they could be transferred by common carrier to CI identified in the permit for diagnostic work. In addition, a blood smear would be made at this time.

CHAPTER 3 DESCRIPTION OF THE AFFECTED ENVIRONMENT

This EA evaluates the potential impacts to the human environment from issuance of the proposed permit and the potential impacts on the social, economic, physical, and biological environment (*i.e.*, targeted shortnose sturgeon), specifically those that may result from the proposed research activities requested.

3.1 SOCIAL AND ECONOMIC ENVIRONMENT

Although economic and social factors are listed in the definition of effects in the NEPA regulations, the definition of human environment states that “economic and social effects are not intended by themselves to require preparation of an EIS.” However, an EIS or EA must include a discussion of a proposed action’s economic and social effects when these effects are related to effects on the natural or physical environment. The social and economic effects of the proposed action mainly involve the effects on the people involved in the research, as well as any industries that support the research, such as suppliers of equipment needed to accomplish the research. There are no significant social or economic impacts of the proposed action interrelated with significant natural or physical environmental effects. Thus, the EA does not include any further analysis of social or economic effects of the proposed action.

3.2 PHYSICAL ENVIRONMENT

The following section provides a description of the critical resources within action area (see link): http://maps.google.com/maps/ms?ie=UTF8&hl=en&msa=0&msid=113286167511014551758.00048f4724bacf8629924&ll=32.852678,-80.19702&spn=1.68432,2.469177&t=h&z=9

3.2.1 *Description of the River Systems in the Action Area:*

3.2.1.1 *Savannah River*:

The Savannah River basin is a 25,900-square-kilometer watershed located in the southeastern United States and includes portions of North Carolina, South Carolina, and Georgia. Flow into the River averages 360 cubic meters. The Savannah River, which is the boundary between South Carolina and Georgia, is formed at Hartwell Reservoir by the confluence of the Seneca and Tugaloo Rivers and flows southeast to the Atlantic Ocean at the port city of Savannah, Georgia. Above the junction of the Seneca and Tugaloo Rivers, the major headwater streams of the Seneca River are the Keowee River and Twelve Mile Creek. The Tugaloo River is formed by the union of the Tallulah and Chattooga Rivers. These headwater streams originate on the southern slopes of the Blue Ridge Mountains in North Carolina and Georgia. The Savannah River has experienced great human impact. Flow, sediment load, and flood plain have been modified by large dams above the Fall line and dredging and channelization below that point. Because of its long history of modification, the Savannah does not have the vast vegetated flood plains in the fresh water tidal zone that are characteristic of other Georgia estuaries.

3.2.1.2 ACE Basin:

The Ashepoo-Combabee-Edisto (ACE) Basin has a largely undeveloped landscape consisting of diverse habitats including pine and hardwood uplands; forested wetlands; maritime forests; fresh, brackish, and salt water tidal marshes; barrier islands; and beaches. The Basin's unique estuarine system provides invaluable habitat for a rich diversity of finfish and shellfish. The Basin hosts a wealth of wildlife resources, including such endangered and threatened species as the bald eagle, wood stork, osprey, loggerhead sea turtle, and shortnose sturgeon, and offers a variety of recreational uses. The ACE Basin is included within the Salkehatchie and the Edisto drainage basins, which comprise approximately four million acres. The southern two-thirds of the ACE Basin are in the Salkehatchie water management area. The Salkehatchie River basin originates in the Sandhills regions and joins with the Little Salkehatchie to form the Combahee River, which empties into St. Helena Sound. This basin also contains drainage for the Ashepoo River. The northern third of the ACE Basin is in the Edisto basin watershed management area. The Edisto River Basin originates in the Sandhills and forms the South Edisto and North Edisto Rivers, which drain into the Atlantic Ocean. The Edisto has approximately 250 miles of unobstructed river, which distinguish it as one of the longest free-flowing black water rivers in the U.S. The lower 38 miles of the Edisto are tidally influenced. The mean range of semi-diurnal tides varies from about 7.2 feet at the mouth of the St. Helena Sound to 6.1 feet in the upper reaches of the estuary. Stream flow in the Edisto River is substantial (74m^3/sec or 2,614 ft^3/sec at Givhan's Ferry) and fairly constant.

3.2.1.3 Cooper River:

The Cooper River Basin encompasses eight watersheds and 843 square miles. The Cooper River Basin incorporates the Lower Coastal Plain and Coastal Zone regions. Of the half a million acres in the Cooper River Basin, 52.7% is forested land, 15.8% is water, 14.5% is forested wetland, 8.3% is urban land, 4.1% is shrub land, 2.6% is agricultural land, 1.6% is non-forested wetland, and 0.4% is barren land. The urban land is comprised chiefly of the greater city of Charleston area. There are a total of 471.2 stream miles in the Cooper River Basin, together with 60,188.5 acres of lake waters, and 13,059.3 acres of estuarine areas. The diverted Santee River flows through Lake Moultrie's Pinopolis Dam and joins Wadboo Creek to form the Cooper River. The Cooper River merges with Mepkin Creek to form the West Branch Cooper River, which then converges with the East Branch Cooper River to reform the Cooper River. The Cooper River then accepts drainage from the Back River, Goose Creek, and the Wando River before flowing into the Charleston Harbor and the Atlantic Ocean.

3.2.1.4 Santee River System Including Lake Marion and its Tributaries:

The Santee River Basin encompasses 11 watersheds and 1,279 square miles. The Santee River Basin originates in the Upper Coastal Plain region of the South Carolina giving way to the Lower

Coastal Plain and the Coastal Zone regions. The major river tributaries northwest of Columbia, South Carolina are the Broad and Saluda with the upper tributary region of the action area including the Saluda-Upper Congaree Sub-basin from the vicinity of the Rosewood Boat Landing adjacent to downtown Columbia, upstream to the Saluda Project Dam on Lake Murray and the Columbia Canal Diversion Dam on the lower Broad River.

The Wateree River begins at the outflow of the Wateree Dam Project from Lake Wateree approximately 78 river miles north of the confluence of the Wateree and Congaree River. The Santee River is formed downstream from the confluence of the Congaree and Wateree Rivers 35 miles downstream of Columbia. The Santee River flows seaward immediately into Lake Marion, and is diverted either out of the Santee dam to eventually drain into the Atlantic Ocean via the South Santee River and the North Santee River, or is channeled along a 7.5 mile diversion canal to fill Lake Moultrie. After flowing through the Santee dam, the Santee River is joined by the rediversion canal connecting Lake Moultrie and the (lower) Santee River.

3.2.1.5 Winyah Bay System:

The Winyah Bay watershed has approximately 18,000 square miles of drainage area including several major rivers including the Waccamaw, the Little Pee Dee, the Great Pee Dee, and the Black River. More than 16,000 square miles of this drainage area is associated with the Pee Dee-Yadkin river system originating in the Blue Ridge Mountains area of North Carolina. Water from this area flows across the Piedmont region of both North and South Carolina into Winyah Bay through the Pee Dee River. The Waccamaw River also receives water from the Pee Dee as the poorly defined, shallow, wide, swampy waterways merge. The Black and Sampit rivers drain much smaller watersheds. The water system experiences a regular semi-diurnal tidal pattern with mean amplitude on the order of 1.4 m at the ocean end of the Bay and 1.0-m at the Sampit River. In the Bay, a salt wedge effect occurs as heavier salt water moves up the estuary along the bottom with the flooding tide, even though the overlying fresh water may be flowing toward the ocean. During periods of low freshwater inflow, flooding tides move salt water more than fifteen miles upstream of the Highway 17 bridges, but under average river flow, the penetration is usually within a mile of the bridges. Differences between surface and bottom salinities during these periods may be more than 20 ppt. Fresh water input into Winyah Bay estuary ranges from 2,000 to about 1,000,000 cubic feet per second (cfs), and the mean runoff is approximately 15,000 cfs. Riverine influence is strong enough to limit ocean water penetration to the lower bay, especially during winter and spring.

3.2.2 *Critical Habitat, National Marine Sanctuaries and EFH*

There are no designated critical habitats located within the area for the proposed activities. Also, there are no protected areas (e.g., National Estuarine Research Reserves or state protected aquatic areas) affected by the proposed research; nor are there eligible historic resources in the project location. However, parts of three National Wildlife Refuges (NWR) operated by the USFWS are transected by river systems within the action area of the proposed research. These are the Savannah River NWR, located upstream from the City of Savannah, GA; Waccamaw NWR, located near Georgetown, SC; and ACE Basin NWR, located near Hollywood, SC. Each refuge is characterized by bottomland hardwoods and tidal freshwater marshes and many impoundments managed for migratory wading birds and waterfowl. They are also home to a large variety of wildlife including ducks, geese, wading birds, shorebirds and several endangered and/or threatened species including, wood storks, manatees and the target species, shortnose sturgeon.

The USFWS has cooperative agreements with the State of South Carolina. Each of its refuges supports study of protected species (under appropriate permitted conditions) occurring within its boundaries. Because of the limited boating and netting activities in aquatic habitats proposed by researchers, NMFS considers the proposed research would have limited environmental impact. The USFWS agreed with our conclusion, stating the proposed activities would not likely adversely affect any listed species under their agency's management. Further, researchers are well aware of the potential of interacting with ESA listed animals in these areas and would follow prescribed means avoiding interaction or disturbing them.

Designated EFH exists for federally managed species in South Carolina rivers within the action area. Specifically, coinciding with the proposed research activities of gill netting, trawling and boating activities, the tidally mixed areas, have designated EFH that could be impacted. A description of specific designated EFH for species within the action area found at: http://sero.nmfs.noaa.gov/hcd/efh.htm; and http://sero.nmfs.noaa.gov/hcd/efh_faq.htm.

With respect to the proposed research activities, NMFS PR concludes minimal potential impacts to EFH of managed species would be caused by the proposed boating, gill netting and trawling activities. Specifically, while the researcher's boats would pass through and over the water column of the action area to retrieve telemetry data from fixed station receivers, NMFS PR considers this activity would not adversely impact the physical environment, including any portion that is considered EFH.

Similarly NMFS PR considers gill netting activities would have no substantial impact on the bottom substrate of rivers located in coastal estuaries, consisting of shallow mud bottoms, to coarse textured sand substrates and some substrates consisting of oyster and marl. Because there would be very little bottom drag by nets on the bottom substrate and benthic organisms, impacts from netting to EFH would be short-term and result in minimal disturbance and no adverse effects.

Lastly, effects of trawling with small epibenthic trawls on EFH were considered in the tidally mixed zone of South Carolina rivers. Dovel and Berggren (1983) found trawling with similar smaller trawls was effective for collecting juvenile shortnose sturgeon in the Hudson River with little impact to bottom substrate. Similar results were obtained when trawling in the upper and lower Connecticut River, the Merrimack River (Permit Nos. 1549 and 1516), the Delaware River (Permit No. 1486 and 14604), and South Carolina rivers (Permit No1505). Conditions placed in these permits have resulted in no sturgeon mortality and minimal impacts documented to EFH over the past five years (T. Savoy, B. Kynard, W. Post; and H. Brundage; pers. com.; Nov 2010). When consulted on each of these former actions, the NMFS Office of Habitat Conservation agreed these prior activities would not impact EFH where it existed in each of these respective action areas.

Therefore, based on these similar trawling restrictions placed in the proposed permit — including using short 10 to 15 minute tow-times, small vessel size, low horsepower, towing at slow speed (3-5 mph), selecting bottom areas conducive to trawling, and using a GPS system limiting substrate disturbance — NMFS considers trawling in the current study would also not adversely impact the physical environment in South Carolina rivers, including any portion having EFH.

NMFS PR contacted the Southeast Office of Habitat Conservation (Beaufort, NC Office) by email on January 3, 2011 asking for concurrence whether the proposed action, as it would be conditioned, would have minimal impacts or not on designated EFH in South Carolina rivers. Results of the informal consultation appear in Section 4.3.2 of this EA.

3.3 BIOLOGICAL ENVIRONMENT

The following is a brief summary of the status and occurrence of targeted shortnose sturgeon range-wide, including the proposed study area. Further descriptions of the status of these species can be found in the Biological Opinion accompanying this document as well as NMFS Recovery Plans and other documents at http://www.nmfs.noaa.gov/pr/publications/.

3.3.1 *ESA Target Species Under NMFS Jurisdiction*:

ESA Endangered: Shortnose sturgeon (*Acipenser brevirostrum*)

3.3.1.1 Range-wide Distribution of Shortnose Sturgeon:

Shortnose sturgeon occur along the east coast of North America in rivers, estuaries and the sea. They were once present in most major rivers systems along the Atlantic coast (Kynard 1997). Their current distribution extends north to the Saint John River, New Brunswick, Canada, which has the only known population in Canada (Scott and Scott 1988). Their southerly distribution historically extended to the Indian River, Florida (Everman and Bean 1898) but the southern limit of their range is currently believed to be in the Saint Johns River, FL (NMFS 1998). They are sympatric with the Atlantic sturgeon throughout much of their range. However, the Atlantic sturgeon spend more of its life cycle in the open ocean. In rivers, shortnose sturgeon and Atlantic sturgeon may share foraging habitat and resources but shortnose sturgeon generally spawn farther upriver and earlier than Atlantic sturgeon (Kynard 1997, Bain 1997). Mangin (1963) theorized the species was primarily found in freshwater on the basis of growth (i.e., if shortnose sturgeons spent more time in the ocean they would grow to larger sizes). In recent years, telemetry data and genetic analyses have demonstrated coastal migrations of shortnose sturgeon between adjacent rivers may be relatively common in some areas (S. Fenandes, T. Squiers-Maine Rivers; & D. Peterson,-S.E. Rivers, pers. comm., 2009).

3.3.1.2 Status of Shortnose Sturgeon in the Action Area:

The population status of shortnose sturgeon in coastal rivers of South Carolina from the Savannah River to the Winyah Bay System is not well documented (NMFS, 1998). However, the system with the largest population estimate in South Carolina is the Savannah River; and, while the estimate is not precise, it is believed to be approximately 3,000 (NMFS, 2004). It is assumed this population is influenced by a stocking trial in the 80's and 90's during which approximately 97,000 shortnose sturgeon were stocked to evaluate the potential for stock enhancement (Smith et al., 2002). However, spawning adults, as well as juvenile shortnose sturgeon, have been captured in the Savannah River. Additionally, prior to 1994 there were very few authenticated records of shortnose sturgeon in the ACE basin and only one record in the lower Ashepoo River (Smith and Collins, 1996). However, more current investigations indicate the Savannah and Edisto River shortnose sturgeon populations are similar genetically (Quattro et al. 2002). Moreover, this evidence suggests that the current Edisto River shortnose sturgeon population has received a major contribution from Savannah River animals with the Edisto population gradually increasing over the past 10 to 15 years

(McCord 2003). Otherwise, the current status of sturgeon stocks in the ACE Basin is poorly understood.

Winyah Bay, the Santee River, and the Cooper River have similar situations in terms of shortnose sturgeon records with no legitimate estimates recognized currently. Collins and Smith (1997) recorded 282 shortnose sturgeon occurrences throughout the Winyah Bay drainage area. It is thought this large basin may currently provide sturgeon access to the vast majority of their historical range of spawning and early nursery habitat was identified by Mills (1826). Presumably, spawning of both Atlantic and shortnose sturgeon presently occurs over more than 200 km (100 mi) of river mainstream in suitable channel habitats in this basin. Available data indicate the presence of spawning stocks of both sturgeons in the basin, but the extent of basin-wide distribution and habitat utilization is also largely unknown (Collins and Smith 1997).

The Santee basin has the second largest drainage area and total discharge of all river systems on the east coast of the United States (Hughes 1994). However, this large watershed has been impacted by damming to a greater extent than most basins on the Atlantic coast of North America, having 88 percent of the river's annual flow diverted into the Cooper River from 1942 through 1985 (Kjerfve and Greer 1978). With the construction of the Santee-Cooper lakes (Moultrie and Marion) in the 1940's, the vast majority of the Santee was closed to migratory fishes. The navigational lock at Pinopolis Dam has been shown to be very ineffective at passing shortnose sturgeon (Cooke et al. 2002; Timko et al. 2003). During the approximately 40 years since the impoundment of the Santee River, average flows in the Santee River seaward of Wilson Dam have been greatly reduced from historical levels (Kjerfve and Greer 1978) with stocks of migratory fish severely impacted. The Santee and Cooper Rivers combined have had only 29 reports of sturgeon passage since the early 1990s (Collins and Smith, 1997). Several hundred adults are believed to inhabit the Cooper River and fertilized eggs have been collected below Pinopolis Dam (Cooke and Leach 2002). However, neither larvae nor juveniles have been collected and successful reproduction has not been confirmed below the dams (Cooke and Leach 2004).

Above the Santee River watershed dams, a dam-locked population of shortnose sturgeon is present in Lake Marion and its tributaries (Saluda, Broad, Congaree and Wateree Rivers) extending to Columbia to the northwest. Radio-telemetry studies conducted by the SCDNR have provided insight into the movements and habitat use of Lake Marion shortnose sturgeon where Collins et al. (2003) documented migration to a spawning site on the Congaree River just south of the city of Columbia (approximately 15 miles downstream of the Saluda Project at Lake Murray). Further telemetry studies, in which Cooper River sturgeon were captured, radio-tagged, and released upstream in the Santee-Cooper Lakes, documented migration of these fish as far upstream as the old Granby Lock and Dam on the Congaree River and also near the town of Wateree, SC on the Wateree River (Bill Post, Doug Cooke, SCDNR, pers. comm.). The old Granby Lock and Dam is located adjacent to downtown Columbia, approximately 11 miles downstream of the Saluda Project and an additional 4 miles upstream of the most upstream migration documented by Collins et al. (2003). Presence of shortnose sturgeon in the vicinity of Granby Lock and Dam was also confirmed by collection of a single specimen during sampling related to relicensing of Duke Energy's Catawba-Wateree Project in March 2004 (Duke Energy, 2004: Catawba-Wateree Hydro Project Diadromous Fish Study Plan, 2004). These studies suggest shortnose sturgeon have the ability to migrate into Piedmont reaches of the Santee Basin downstream of the Saluda Project.

Sustainability of the population within the lakes is unknown, but dam-locked sturgeon populations tend to be in poorer conditions than open river populations (Collins et al. 2003). The genetic relationship of animals from this population to those in the Cooper and Santee Rivers is not yet clear, though a preliminary study shows animals within the lakes and in the Cooper River to be genetically similar (Collins et al. 2003).

3.3.2 *ESA Non-Target Species in the Action Area*:

In addition to the target species, a wide variety of non-target species can be found within separate sections of the action area, including marine mammals, sea turtles, invertebrates, teleost and elasmobranch fish, and sea birds etc. However, merely being present within the action area does not necessarily mean the organism will be affected by the proposed action. Thus, the following discussion focuses on the distribution and abundance of only those species most likely affected by the proposed research activities.

Highlighted in Table 4 is a summary of the non-target ESA threatened or endangered species occurring in South Carolina's major river systems associated with the proposed research and managed under either NMFS or USFWS jurisdiction

Table 4: Summary of non-target ESA species potentially affected by the proposed action.

Species	Location	Occurrence & Potential Interaction	Federal ESA Status/ Agency
American alligator (*Alligator mississippiensis*)	Freshwater/ Brackish Boundary	Common/Intermittent	Threatened(SOA*)/FWS
Florida manatee (*Trichechus manatus*)	Freshwater Inlets/ Estuary	Intermittent/Intermittent	Endangered (FWS)
Wood stork (*Mycteria americana)*	Freshwater/Brackish Boundary	Rare but increasing/ Low	Endangered (FWS)
Green sea turtle (*Chelonia mydas*)	Brackish/Estuary	Low/ Low	Threatened (NMFS-FWS)
Kemp's ridley sea turtle (*Lepidochelys kempii*)	Brackish/Estuary	Low/ Low	Endangered (NMFS-FWS)
Leatherback sea turtle (*Dermochelys coriacea*)	Off-shore Ocean Waters	Very Low/ Very Low	Endangered (NMFS-FWS)
Loggerhead sea turtle (*Caretta caretta*)	Brackish/Estuary	Low/ Low	Threatened (NMFS-FWS)
Hawksbill sea turtle (*Eretmochelys imbricata*)	Off-shore Ocean Waters	Very Low/ Very Low	Endangered (NMFS-FWS)
Finback whale (Balaenoptera physalus)	Off-shore Ocean Waters	Very Low/ Very Low	Endangered (NMFS)
Humpback whale (Megaptera noaveangliae)	Off-shore Ocean Waters	Very Low/ Very Low	Endangered (NMFS)
Right whale (Balaena glacialis (incl. australis)	Off-shore Ocean Waters	Very Low/ Very Low	Endangered (NMFS)

*Listed threatened by similarity of appearance (SOA) by the USFWS

3.3.2.1 ESA Non-target Species Under USFWS Jurisdiction:

American alligator: (The following is a summary from http://ecos.fws.gov/ and from http://www.fws.gov/species/species_accounts/bio_alli.html).

The American alligator, formerly listed as endangered, both on the federal and state lists, is currently listed as "threatened by similarity of appearance (SA)" throughout South Carolina because of its likeness to other protected crocodilians worldwide. Today the species is considered secure both statewide and globally (Nature Serve 2005), occurring commonly in freshwater inland rivers and wetland areas in coastal counties in of South Carolina. Large, protected populations exist on some government-owned lands, such as the Savannah National Wildlife Refuge and Donnelly Wildlife Management Area. Alligators have been reported by the applicant in abundance throughout the proposed range of research with numerous researcher sightings during boating activities; however, none have been captured by researchers.

Florida manatee: The Florida manatee is listed as endangered under the ESA under the USFWS's jurisdiction and is protected under the MMPA. They inhabit both marine and fresh water of sufficient depth (1.5 meters to usually less than 6 meters) throughout their range of the southeastern U.S., including low numbers in South Carolina waters as intermittent, seasonal inhabitants. Manatees spend much of their time underwater or partly submerged, making them difficult to detect even in shallow water. Therefore there is intermittent potential for interaction with manatee within the research area. The researchers expect interaction with this species to be a low probability occurrence, and given the measures to avoid capture of manatees that would be incorporated into the researchers' methodology, NMFS believes that measures introduced by the USFWS in Section 4.58 of this EA are sufficient to level that they minimize risks for interaction or harm to manatee

Wood stork: In the United States, wood storks are concentrated on coastal areas of Florida, Georgia, and South Carolina. After the breeding season, wood storks can be found throughout the Southeastern Coastal Plain. Endangered wood stork favor cypress trees in marshes, tidal and freshwater swamps and other coastal wetlands of South Carolina. The applicant has incidentally sighted wood stork in several locations, primarily birds on foraging flights overhead on the Savannah and Edisto River. However, the applicant indicated they would not anticipate much opportunity from his research adversely impacting wood stork, but they would agree to avoid wood storks if encountered. Thus, NMFS considers potential disturbance of feeding, resting or roosted wood stork possible, but not likely in the proposed research activities.

Summary: NMFS PR concludes impacts are possible on non-target listed species under USFWS jurisdiction, but they would not likely cause adverse impacts. NMFS thus requested concurrence (sent by email on January 3, 2011) from Ms. Nicole Adimey of the USFWS North Florida Field Office regarding the manatee; and from Mark Caldwell from the USFWS Charleston, South Carolina Ecological Services Office (sent by email on January 5, 2011) on the other species occurring in the action area. Results of informal consultations with USFWS on species under their jurisdiction follow in Section 4.3.1.2 of this EA.

3.3.2.2 Other Non-targeted Protected Species Occurring in the Action Area:

Sea Turtles: As highlighted in Table 4, five species of sea turtles have been documented in South Carolina waters, and are joint ESA listed under jurisdiction of NMFS (in marine waters) and USFWS (on land). However, occurrences of the hawksbill sea turtle are very rare within the action area due to their preferred feeding habits on sponges and corals (not abundant in South Carolina waters). Also, although leatherback sea turtles have been documented in the lower Cape Fear River, located north of the action area, they occur almost exclusively in open ocean waters (J. McNeill, pers. com.). However, because green turtles, Kemp's ridley and loggerheads are more specialized feeders, grazing on sea grasses and algae in coastal environment (estuaries, bays and inter-coastal waterways), they potentially could be impacted by boating activities of researchers while in transit to sonic receivers locations in the more brackish waters of estuaries. However, because no sea turtles frequent fresh water locations where netting and trawling activities are proposed in rivers, and no interactions with sea turtles have taken place during similar netting activities, NMFS PR does not believe sea turtles would be encountered or adversely affected by netting activities. (See also Section 4.5.9 of this EA).

- *Endangered whales*: Federally endangered humpback, sei and northern right whales are found seasonally (fall and winter) off-shore in deeper waters of South Carolina; however these animals are not known to occur in near-shore areas of South Carolina. As such, NMFS PR has determined these listed whales would not likely to occur in the action area where research activities would occur. However, measures would be in place in the permit while boating. During all boating activities (including travel to acoustic receiver arrays) researchers would be advised to keep a close watch for all marine mammals to avoid harassment or interaction and also advised to review the NMFS Southeast Region Marine Mammal Approach and Viewing Guidelines located online at (http://www.nmfs.noaa.gov/pr/education/regional.htm#se)

- *Bottlenose dolphins* (*Tursiops truncatus*): Bottlenose dolphins are marine mammals protected under the MMPA, but are not listed as threatened or endangered under the ESA. They are known to occur periodically in the parts of the action area, including the estuary and upstream tidally influenced portions of the South Carolina rivers, estuaries and bays. Bottlenose dolphins could therefore potentially become entangled within the nets; however, the applicant indicated entanglements have not occurred in the freshwater areas where netting would be taking place during the last 15 years of directed studies.

Consequently, NMFS PR does not expect adverse impacts with bottlenose dolphins. However, as precautionary measures, the measures listed in Section 4.5.10 would be applied in permits, namely: netting would not be deployed when animals are observed within the vicinity of the research; and animals would be allowed to either leave or pass through the area safely before net setting is initiated. Should any dolphin enter the research area after the nets have been deployed, the lead line would be raised and dropped in an attempt to make marine mammals in the vicinity aware of the net. If marine mammals remain within the vicinity of the research area or approach the set, nets would be removed.

Additionally, in all boating activities — including travel to acoustic receiver arrays outside of the netting area — researchers would be advised to keep a close watch for marine mammals to avoid harassment or interaction and also to review the NMFS Southeast Region Marine Mammal Approach and Viewing Guidelines (http://www.nmfs.noaa.gov/pr/education/regional.htm#se).

3.3.2.3 Non-Listed Bycatch Species:

The applicant supplied NMFS results of bycatch from individual rivers in the action area (See Table 1-3, Appendix 3). Because nets would typically be checked at short intervals, it is believed virtually all bycatch would be released alive. Additionally, because there is likelihood for Atlantic sturgeon, a NMFS "species of concern" appearing as bycatch in netting efforts, the following discussion on Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*) is provided.

- *Atlantic sturgeon*: Atlantic sturgeon is currently a "candidate species" under NMFS jurisdiction, co-occurring with shortnose sturgeon in South Carolina rivers. Thus, there is potential for Atlantic sturgeon to be captured during the proposed study. In 1998, NMFS and USFWS received a petition to list Atlantic sturgeon as endangered. Although a protective ESA status was denied, the species remained a 'species of concern' under NMFS's jurisdiction. In 2007, NMFS completed a second status review for this species and accepted a petition evaluating whether the species warrants listing under the ESA. Subsequently, Atlantic sturgeon were proposed for listing in five projected distinct population segments (DPS). A proposed threatened DPS in the Gulf of Maine was determined, while the remaining four DPS were proposed as endangered (75 FR 61872 & 75 FR 61904).

Currently, however, a final rule has not yet been published and this species does not receive protections under the ESA. Thus, NMFS considers should a subsequent listing of Atlantic sturgeon occur coinciding with the proposed research activities, the effects of the researcher's actions on Atlantic sturgeon would be analyzed at that time. Appropriately, the applicant would monitor gill nets closely, and if an Atlantic sturgeon were captured prior to its final listing, NMFS would request the same netting protocols and standard research conditions for shortnose sturgeon be used to ensure Atlantic sturgeon survival (See Section 4.5.11 of this EA). If a listing occurs during the permitted time frame authorized for shortnose sturgeon, the researcher would be required to consult with NMFS for coverage of any incidental takes of Atlantic sturgeon.

3.3.2.4 Aquatic Nuisance Species:

The U.S. Geological Survey has documented aquatic nuisance species (USGS 2010) occurring in South Carolina River watersheds including: flathead catfish (*Pylodictis olivaris*); Asian clam (*Corbicula fluminea*); water hyacinth (*Eichhornia crassipes*); hydrilla (*Hydrilla verticillata*); parrot feather (*Myriophyllum aquaticum*); alligatorweed (*Alternanthera philoxeroides*); and Brazilian waterweed (*Egeria densa*). Because the proposed research activities have the potential to spread such aquatic nuisance species to other watersheds, measures proposed by NMFS, outlined in Section 4.5.12 of this EA, were agreed to be implemented by the researcher as standard research practices.

For further information on the affected biological environment, please refer to the Biological Opinion written for this proposed action.

CHAPTER 4: ENVIRONMENTAL CONSEQUENCES

This chapter represents the scientific and analytic basis for comparison of the direct, indirect, and cumulative effects of the alternatives. Regulations for implementing the provisions of NEPA require consideration of both the context and intensity of a proposed action (40 CFR Parts 1500-1508).

4.1 EFFECTS OF ALTERNATIVE 1: NO ACTION

An alternative to the proposed action is no action, i.e., denial of the permit request. This alternative would eliminate any potential risk to all aspects of the environment from the proposed research activities. However, it would also prohibit researchers from gathering information that could help endangered and protected shortnose sturgeon.

4.2 EFFECTS OF PROPOSED ALTERNATIVE 2: ISSUANCE OF PERMIT WITH STANDARD CONDITIONS

Any impacts of the proposed action would be limited primarily to the biological environment, specifically the animals that would be studied or affected by the research. The type of action proposed in the permit request would minimally affect the physical environment and would be unlikely to affect the socioeconomic environment or pose a risk to public health and safety.

4.2.1 *Effects of Research Activities on the Target Species*:

The permit would authorize non-lethal, year round sampling of the Savannah, Edisto, Cooper, Santee Rivers Winyah Bay System, and Santee-Cooper Lakes with anchored and drift gill nets, trammel nets and trawls. Up to 154 shortnose sturgeon would be captured, measured, weighed, sampled for genetic tissue analysis, PIT and dart tagged. Additionally, up to 110 sturgeon from all rivers would be anesthetized and implanted with internal sonic transmitters. In addition, shortnose sturgeon sex would be determined from a sample of 24 fish annually from the Cooper River by visually identifying organs by performing laparoscopy with biopsy. After sex and health determination is made, blood samples would be collected from each fish and processed determining endocrine disrupters. Additionally, lethal collection of up to 50 eggs and larvae from both the Savannah River and Lake Marion (and tributaries) would take place during seasonal spawning activity using artificial substrates. Lastly, up to 20 young of year (YOY) would be sampled with epibenthic trawl in Lake Marion (and its tributaries), Savannah, Edisto, Cooper, Santee, and Pee Dee Rivers. No unintended sturgeon mortality or serious harm resulting from research would be authorized.

4.2.1.1 *Effects of Capturing*:

Entanglement in nets could result in injury and mortality, reduced fecundity, or delayed or aborted spawning migrations of sturgeon (Moser and Ross 1995, Collins *et al.* 2000, Moser *et al.* 2000, and Kahn and Mohead, 2010). Historically, the majority of shortnose sturgeon mortality during scientific investigations with nets has been related to factors such as water temperature, low D.O concentration, netting duration, meshes size, net composition, and the level of netting experience of the researcher (See Table 5 below).

Table 5: Number and percentage of shortnose sturgeon killed by gill/trammel nets and trawls associated with scientific research permits prior to 2005						
	Permit Number					
	1051	1174	1189	1226	1239	1247
Time Interval	1997, 1999 – 2004	1999–2004	1999, 2001 – 2004	2003–2004	2000 – 2004	1988 – 2004
Sturgeon captured	126	3262	113	134	1206	1068
Sturgeon mortality	1	7	0	0	5	13
Percentage mortality	0.79	0.22	0	0	0.41	1.22

In 2005, NMFS PR began analyzing the results of previous research and updating permit conditions reducing the stress and mortality to shortnose sturgeon during capture. Since that time, there have been only two recorded mortalities caused during their capture using newer NMFS protocols (See Table 6 below). The primary causes of mortality identified during a review of permits issued prior to 2005 were high temperatures, low dissolved oxygen, long net set durations and complete occlusion of gills by mesh causing asphyxiation. The two instances of mortality since 2005 were caused by pulling a snagged net free while a fish was tangled, and another case of occluded gills.

Despite the success of permit modifications reducing mortality of sturgeon, there is potential for undocumented delayed mortality. Although there is no way to estimate the rate of delayed mortality, NMFS believes it would be small based on reports of various species of sturgeon captured and transported to rearing facilities.

Table 6: Number of shortnose sturgeon mortalities under recent scientific research permits		
Permit Number	Shortnose sturgeon captured	Shortnose sturgeon mortalities
1420 (2005-2009)*	1472	0
1447 (2006-2010)	107	0
1444 (2005-2009)*	1	0
1449 (2007-2009)*	50	0
1486 (2006-2009)*	416	0
1505 (2006-2010)	279	0
1516 (2007-2010)	344	0
1547 (2006-2010)	150	0
1549 (2006-2010)	522	0
1575 (2007-2010)	14	0
1580 (2007-2010)	112	0
1595 (2007-2010)	695	1
10037 (2007-2010)	235	0
10115 (2008-2010)	12	0
14394 (2010)	383	
14604 (2010)	34	1
14759 (2010)	0	0
Totals	4,826	2

*Permit currently expired

- *Anchored Gill/Trammel Netting*: To limit stress and mortality of sturgeon captured with gill and trammel nets, netting activity would cease in waters below 0ºC and above 28ºC. Anchored gill nets would be required to be constantly monitored with one exception: overnight sets for up to 14 hours would be authorized in freshwater at or above river mile 40 in the Edisto River and at water temperatures below 15 ºC during November and March. Otherwise, at water temperatures between 15ºC and 20ºC, net sets would not exceed four hours; at water temperatures between 20ºC and 25ºC soak times would not exceed two hours; and at water temperatures between 25ºC and 28ºC soak times would not exceed one hour. Additionally, all netting would occur in waters having minimum dissolved oxygen (D.O.) concentrations of 4.0 mg/L during deployment. The applicant has maintained a verifiable record of zero mortalities using current NMFS netting protocols while engaged in other similar gillnetting for shortnose sturgeon in South Carolina rivers (Permit No.1447; Permit No. 1505-01). Thus NMFS does not believe gillnetting as described would be a significant source of mortality or harm to sturgeon.

- *Drift Gill Netting*: Drift gillnets can be used very effectively capturing sturgeon by drifting through relatively snag-free areas while dragging near or on the bottom (O'Herron and Able 1990, McCord 1998). This method can be used through upriver runs and pools without large entanglements by using very light lead line (just enough to take the net to the bottom). Often this method results in lower debris loading because the nets drift along with the debris and does not intercept it. Generally, the short soak times, 30 minutes to two hours, and reduced pressure on the driftnets also result in less injury, stress or mortality to captured fish. And, because drift nets are checked at short intervals, and sturgeon are removed when it becomes obvious a fish is captured, they are less likely to experience stress when captured.

- *Trawling***:** Most negative effects to captured sturgeon related to trawling occur as a result trawl speed and duration (Moser *et al.* 2000). However, by proposing trawling as employed in the upper and lower Connecticut River (Permit No. 1549 & 1516), Delaware River (Permit 14604) and in the applicant's previous permit in South Carolina rivers (Permit No. 1505-01) — these trawling methods have yielded no mortalities and limited impacts on the bottom substrate — NMFS anticipates the applicant's trawling in South Carolina rivers would have similar outcomes.

To limit effects of trawling the applicant would trawl at slow speeds (3 – 5 mph), tow for no more than ten minutes, and avoid multiple trawls over the same area during a twenty-four hour period using a GPS unit. Trawling would primarily be conducted over sand substrates avoiding hard bottoms, vegetated areas, organic material, or woody debris to avoid snagging. If the trawl does become entangled in debris, efforts would begin immediately to free the gear, thus avoiding potential injury to targeted or non-targeted species. Based on proposed use of the trawl, and previous positive results using the same trawling conditions as in other research, NMRS PR does not anticipate negative impacts from the applicant's proposed trawling.

- *Egg/Larvae Collection Using Buffer Pads*: Collection of sturgeon eggs or larvae is important to the documenting the presence or absence of spawning, the location of spawning areas, and the timing of the spawn. The buffer pads deployed in the Savannah River and Lake Marion (and its tributaries) would be 22" diameter pads to passively collect eggs adrift. Due to their small size and low profile, these pads would not disrupt the flow of the water or the habitat around it. Embryos having dislodged or drifted would potentially settle on the pads and then would be taken back to the lab to verify age and time of spawning when compared to preserved eggs of known age. Fifty eggs or larvae would be authorized to be captured annually from all locations and would be lethally preserved and stored in 95% ethanol and verified as shortnose sturgeon embryos by trained biologists. Because shortnose sturgeon are broadcast spawners and lay thousands of eggs at a time (Dadswell, 1979; McCabe and Beckman, 1990; Marchette and Smiley, 1982), it is believed the small number of eggs requested would not have an adverse effect on the population's viability. Should there be an excess of authorized take, they would immediately be returned to the river.

4.2.1.2 *Effects of General Handling (e.g., Holding, Measuring, Weighing)*:
Sturgeon are a hardy species, but are sensitive to handling stress when water temperatures are high or dissolved oxygen levels are low. Handling stress can also escalate if sturgeon are held for long periods after capture; and conversely, stress is reduced the sooner fish are returned to their natural environment to recover (D. Peterson, pers. comm. November 2008). Signs of handling stress are redness around the neck and fins and soft fleshy areas, excess mucus production on the skin, and rapid flaring of the gills. Additionally, sturgeon tend to inflate their swim bladder when stressed and when handled in air (Moser *et al.* 2000). If not returned to neutral buoyancy prior to release, sturgeon tend to float and become susceptible to sunburn and bird attacks. In some cases, if pre-spawning adults are captured and handled, it is possible that they would interrupt or abandon their spawning migrations after being handled (Moser and Ross 1995).

To ensure sturgeon are fully recovered, just prior to being released, all fish would be recovered in a net pen by holding the fish upright and immersed in river water and gently moving the fish front to back to aid freshwater passage over the gills to stimulate the fish. If showing signs of being able to swim away strongly, the fish would be released head down and a spotter would watch to make sure the fish stays down and fully recovered.

Although sturgeon are sensitive to handling stress, the proposed methods of handling fish, as described in the application and in this EA, are consistent with the best management practices recommended by NMFS in Kahn and Mohead (2010), and, as such, these measures (Section 4.5.2 of this EA) should minimize the potential handling stress and indirect effects resulting from handling.

4.2.1.3 *Effects of Genetic Tissue Sampling*:
The applicant proposes to take small (1 cm^2), non-deleterious tissue samples, clipped with sterile surgical scissors from sections of soft pectoral fin rays of captured sturgeon. Tissue sampling does not appear to impair the sturgeon's ability to swim and is not thought to have any long-term adverse impact (Wydoski and Emery 1983). Many researchers, including the applicant, have reported routinely removing tissue samples with no adverse effects; therefore, NMFS does not anticipate any long-term adverse effects to sturgeon from this activity.

4.2.1.4 *Effects of PIT Tagging*:
The PIT tags used for permanently marking and identifying individual captured fish would be 11.5 mm by 2.1 mm tags, activated at a radio frequency of 134 kHz. The PIT tags would be injected 1 cm into the left dorsal musculature just anterior to the dorsal fin using a syringe equipped with a 12 gauge needle. These biologically inert tags have been shown not to cause problems associated with some other methods of tagging fish such as scarring and damaging tissue or otherwise adversely affecting growth or survival (Brännäs *et al*. 1994).

Henne *et al*. (2008) found that both 11.5 and 14.0 mm PIT tags can be safely implanted into juvenile shortnose sturgeon 300 mm or greater total length (TL). However, as fish size decreases below 300 mm TL, factors other than fish length (e.g., fish weight, condition factor) were discovered to affect post implant survival. As such, the applicant's proposed method of tagging of shortnose sturgeon above 300 mm with 11.5 mm PIT tags is unlikely to have significant impact on the reproduction, numbers, or distribution of shortnose sturgeon. And to avoid duplicate tagging, all sturgeon captured would be scanned with a PIT tag reader prior to the insertion of a PIT tag. Additionally, results of PIT tag retention would be reported to NMFS in annual reports to document PIT tag retention.

4.2.1.5 *Effects of Using Dart Tags*:

The applicant requested an additional externally identifiable tagging method using dart tags during the study, suggesting the additional information gained from visible tags would be important because any identification of recaptured sturgeon from South Carolina waters should be reported as soon as possible by commercial and recreational fishermen as well as the scientific community.
Smith *et al.* (1990) compared the effectiveness of dart tags with nylon T-bars, anchor tags, and Carlin tags in shortnose and Atlantic sturgeon taken from South Carolina waters. Carlin tags applied at the dorsal fin and anchor tags in the abdomen showed the best retention, and it was noted that anchor tags resulted in lesions and eventual breakdown of the body wall if fish entered brackish water prior to their wounds healing. However, Collins *et al.* (1994) found no significant difference in healing rates (with T-bar tags) between fish tagged in freshwater or brackish water. Clugston (1996) also looked at T-bar anchor tags placed at the base of the pectoral fins and found that beyond two years, retention rates were about 60%. Collins *et al.* (1994) compared T-bar tags inserted near the dorsal fin, T-anchor tags implanted abdominally, dart tags attached near the dorsal fin, and disk anchor tags implanted abdominally. They found, long-term, dart and T-bar anchor tags were most effective (92%), but also noted minor, slow-healing lesions at the insertion points.

Although NMFS concludes the use of dart tags to externally mark shortnose sturgeon is a duplicative means of identifying captured fish— a practice not encouraged by NMFS due to potential additional handling stress—the practice is not expected to significantly impact sturgeon health. However, to lessen known negative impacts described above using the dart tag, researchers would use sterile tagging technique and subsequently monitor dorsal fins tag sites of recaptured sturgeon. Additionally, results of tag retention and fish health would be reported to NMFS PR in annual reports and as periodically requested by NMFS. If impacts of the dart tags are other than insignificant, NMFS would reevaluate their further use in the permit.

4.2.1.6 *Effects of Implanting Acoustic Transmitters*:

In each year of the study, up to 90 shortnose sturgeon adults and sub-adults from each South Carolina river basin would be anesthetized and surgically implanted with an internal acoustic transmitter using the outlined protocol presented in Section *2.3.4.6* of this EA.

The applicant has recorded in annual reports to NMFS (Permit Nos. 1447 and 1505-01) surgically implanting acoustic tags in over 100 adult and juvenile shortnose sturgeon experiencing no mortalities or adverse effects directly attributable to such implanting. The behavior of acoustically tagged shortnose sturgeon in the past (with some fish tracked for periods greater than two years) suggests the research methods used have had little verifiable negative effects on individual animals.

In other research, Collins (M. Collins, SC DNR; pers. comm., November 2006) tracked radio tagged shortnose sturgeon for two years and documented no mortality from surgical implantation of internal transmitters. Additionally, Kieffer and Kynard (*In press*) reported tag rejection internally was reduced by coating tags with an inert elastomer and by anchoring tags to the body wall with internal sutures. All fish retained tags for their operational life, and in most cases, lasted much longer (mean, 1,370.7 days). Devries (2006) reported on the movements of 8 male and 4 female (≥ 768 mm TL) shortnose sturgeon internally radio-tagged between November 14, 2004 and January 14, 2005, in the Altamaha River, Georgia. Nine of these fish were tracked until the end of 2005. Although no mortality or serious harm was directly documented for these fish, the remaining five individuals were not accounted for and were censored after movement was not detected, or they were not relocated, after a period of four months. This later account signals the potential for adverse delayed (indirect) effects from such tagging. Thus, while often not verifiable, NMFS believes the surgical implantation of acoustic transmitters can have the potential to injure or kill shortnose sturgeon.

In general, direct effects of the proposed tagging procedure could include pain, handling discomfort, hemorrhage at the site of incision, risk of infection from surgery, affected swimming ability, and/or abandonment of spawning runs. However, use of proper anesthesia, sterilized conditions, and the surgical techniques described above, would minimize potential short-term effects from tagging and greatly lower the long-term risks of injury and mortality. Further, all telemetry tags that would be used by the applicant are currently manufactured with inert elastomer coatings.

Other precautions used by the applicant to minimize adverse impacts on sturgeon have included implanting transmitters only in non-stressed fish of excellent condition, and not attempting the procedure with pre-spawning fish in spring, or when the water temperature exceeds 27° C or when less than 7° C. To verify normal mobility and swimming behavior of sturgeon receiving internal transmitters, the total weight of all transmitters and tags would not exceed 2% of the weight of the fish. Additionally, the applicant proposes to document tag adaptation by individually tracking fish, recording swimming behavior, logging the number of times each fish is detected and the time periods between detection, and the number of unrelocated individuals. NMFS therefore expects the tagging would result in primarily short-term stress to the animal with some unverifiable mortality resulting from such tagging.

Lastly, many fish have sensitivity to sound energy from 200 Hz up to 800 Hz, and some species are able to detect lower frequency sounds (Popper 2005). However, the potential for the proposed internal sonic transmitters to affect a sturgeon carrying them would be small because the frequency of the acoustic tags is 69 kHz, well above the audible threshold of most fish. NMFS also considered unverified potential for predation on tagged sturgeon sharks or other animals having hearing capability in the range of the proposed tags (B. Southall, pers. comm., November 2009). However, based on the implantation and subsequent successful tracking of acoustic tags in other sturgeon species by the applicant, NMFS does not believe such predation is an extensive risk for shortnose sturgeon tagged with acoustic tags.

4.2.1.7 Effects of Anesthesia for Transmitter Implantation:

The proposed anesthetic concentration of up to 150 mg/L MS-222 for internal acoustic tagging is commonly used by sturgeon biologists to induce light to deep planes of (D. Peterson, D. Fox, M. Collins, T. Savoy, pers. comm. Nov. 2009). The induction varies with dosage, water temperature and water chemistry; however, typical induction times are from five to eight minutes. Because telemetry tags can be inserted into the coelom in less than a minute with little reaction to the external stimuli when incised (muscle spasm, contraction), there is little risk to the sturgeon in this regard (M. Matsche; pers. comm.; December 2009). Complete recovery time from the anesthetic averages four to six minutes (Brown 1988).

Risks associated with anesthetizing with MS-222 at this level would include hypoxia from overexposure (possibly caused by inexperience at recognizing the proper level of narcosis) (Coyle *et al.* 2004), anesthetizing fish in poor health or stressed conditions, and injury from thrashing during the excited phase of anesthetic induction. To reduce such risks, the applicant is experienced and accomplished in transmitter implantation using the anesthetic MS-222. Further, only non-stressed animals in good health would be anesthetized for internal tagging. Fish would be monitored closely during induction to reach the proper level of anesthesia prior to surgery, and would be watched to ensure proper recovery from anesthetic narcosis prior to release. To avoid injury while being anesthetized, sturgeon would be restrained with netting over container for the anesthetic bath to prevent animals from jumping or falling out. Also, because MS-222 is an acidifying solution, potentially extending the induction time for narcosis, bath solutions would be buffered to a neutral pH with sodium bicarbonate and also oxygenated prior to use.

MS-222 has been found to be excreted in fish urine within 24 hours and tissue levels decline to near zero in the same amount of time (Coyle *et al*., 2004). Consequently, sturgeon released after treatment, would not present a sizable risk to the environment should potential predators consume a sturgeon. Additionally, an existing FDA 21-day withdrawal period for MS-222 applied to food-fish for human consumption would not be applicable for endangered shortnose sturgeon since they are a federally protected species with prohibitions against take. (F. Pell; FDA; pers. comm.; email; 2/24/2009). Therefore, NMFS considers this anesthetizing protocol for internal tagging to be well established with known risks producing limited effects on the sturgeon and the environment.

4.2.1.8 Effects of Laparoscopic Examination, Gonad Biopsy and Blood Collection:

Laparoscopy and Biopsy: Laparoscopy is a modified minimally invasive procedure refined for sturgeon research to determine the general morphological health and to visually identify the sex of fish accurately. The same procedure is also used for obtaining biopsy samples. These procedures performed on other fish species (Murray, *et al.*, 1998; Moccia *et al*., 1984; Ortenberger *et al*., 1996; Stoskopf, 1993) have also been advanced for sturgeon and used extensively by Warm Springs Regional Fisheries Center (Hernandez-Divers *et al*. 2004). During laparoscopic examinations (~5-8 minutes), a 5 mm incision is made in the ventral body wall slightly off midline at a level midway between the pectoral girdle and the cloaca. A 5mm trocar is inserted through the incision and a 5-mm rigid laparoscope is then be inserted through the trocar to allow visualization of the internal anatomy of the animal. In those instances where the sex of the animal is not readily apparent during examination, an added exploratory biopsy (~5 minutes) procedure of the gonadal tissues would be undertaken through a secondary small incision made below the first. Gonad biopsy samples do not cause disruptive hemorrhaging of the sampled site because of the lack of blood vessels in the vicinity of the sampled site.

The procedures would increase the risk of complications associated with the added stress of surgical procedures and the time under anesthesia. Because the sutures used to close the laparoscopy sites penetrate the body wall, they would also provide a route of possible infection. To combat these risks of surgery, the researchers would use sterile surgical technique and small incisions, minimizing the amount of suture necessary and decreasing the healing time. Finally, suture ties would be kept as short as possible and iodine ointment would be applied to the sutures prior to recovery from anesthesia. This treatment would help prevent fungal growth on the sutures possibly infecting the animal prior to healing.

In addition to the above complications, there has been a documented risk associated with an autonomic reaction by the sturgeon undergoing laparoscopic surgery as the coelom is probed by laparoscopic instruments. That is, while inside the fish, there is potential for the instrument to cause hemorrhagic trauma upon sudden reaction by the animal during surgery. The researcher's request for 250 mg/L MS-222 induction of surgical anesthesia would lessen the potential for this reaction.

In tests with induction doses of MS-222 (i.e., 100, 150 200 and 250 mg/L), researchers found shortnose and Atlantic sturgeon were not adequately anesthetized to nociceptive stimuli and sometimes violently reacted with tail flexions and body arching when cannulas were inserted into the coelom during laparoscopic examinations at doses of 100 and 150 mg/l (M. Matsche, unpublished data). However, in tests using the 250mg/l MS-222 dose, shortnose sturgeon remained stable and experienced no such reactions throughout laparoscopic examinations (M. Matsche, unpublished data).
Each of the project staff performing laparoscopic examinations and obtaining biopsy samples would be trained in the procedure having performed similar procedures on shortnose sturgeon without complication in other NMFS permitted activity (Permit No. 1505). Under proper anesthesia, with proper training and experience, the small incisions and insertions of the laparoscope and biopsy sample would have little probability of killing or producing sub-lethal effects as the surgery. Further, the fish's potential reaction would predictable when the sturgeon is under proper surgical anesthetic state. Additionally, the healing process is rapid for this procedure.

Anesthesia for Laparoscopic Surgery: The proposed anesthesia protocol for laparoscopic surgery calls for rapid induction of surgical anesthesia using a 250 mg/L buffered solution of MS-222 followed immediately by an 87.5 mg/L maintenance dose of MS-222 during surgery. The researcher's goal would be to rapidly achieve the desired plane of surgical anesthesia while minimizing stressful effects on animals during laparoscopic examination (Summerfelt and Smith 1990).

The primary risks of inducing anesthesia on sturgeon with 250 mg/l MS-222 are overexposure and overdosing, buildup of stress response hormones such as Cortisol, and inadvertent trauma to internal organs caused by reaction to laparoscopic instruments (as described above). Overexposure occurs when sturgeon are left in an anesthetic bath longer than necessary to achieve the proper narcosis. Overdosing, however, takes place when the concentration of anesthetic is more toxic than the fish can tolerate. Both can cause lethal or sub-lethal effects.

The rate at which anesthesia is induced is important in minimizing stress. Anesthetized animals tend to have reduced stress when narcosis and recovery is rapid. Marking and Meyer (1985) provided characteristics of an appropriate anesthetic protocol, stating it should include both a rapid induction time (<5 minutes) and rapid recovery time (<10 minutes, faster for lighter sedation). Using the proposed initiating dose of 250 mg/L MS-222 to rapidly induce surgical anesthesia, the average induction times approximates 2-5 minutes (M. Matsche, 2009; unpublished data). Surgical anesthesia would be reached when the fish exhibits complete loss of equilibrium, decreased muscle tone and reaction to massive stimulation, while maintaining a depressed ventilation rate and regular heart rate (Ross and Ross 1999; Summerfelt and Smith 1990).

As discussed above, there is risk associated with an unpredictable autonomic reaction of sturgeon when undergoing laparoscopy when using lower dosages of MS-222. Hemorrhagic trauma can occur if a blood vessel is punctured by instruments. The researcher's request for 250 mg/L MS-222 induction of rapid surgical anesthesia has been documented to stop the potential for inadvertent trauma caused by laparoscopic instruments (M. Matsche, unpublished data). Animals no longer respond to the internal probing of the laparoscopic instruments at this level of narcosis, referred to as surgical anesthesia by Summerfelt and Smith 1990.

The potential for overexposure resulting in lethal or sub-lethal effects on sturgeon if sturgeon are left unattended in the high concentration. Overexposure to such concentrations could be related to the researcher's level of experience or his inability to recognize the induction point of surgical anesthesia. In interviews with other biologists performing similar anesthetic and laparoscopy protocols (D. Peterson, W. Post, and , J. Gibbons; pers. comm.; November 2009), proper training and experience in the procedure — knowing what to expect, as well as using proper equipment — are important factors for developing proficiencies in the protocol. To minimize exposure risks, the applicant has trained research staff with extensive experience in the laparoscopy, having routinely performed multiple similar procedures without complication (Permit No. 1505-01). Additionally, equipment used to induce surgical anesthesia would also include a heart rate monitor assisting in identifying the proper induction point of surgical anesthesia, thereby minimizing overexposure to the higher concentration of MS-222.

With regard to cortisol stress response, Matsche (unpublished data) found cortisol hormone levels differ with respect to the level of anesthesia used for laparoscopic surgery. Specifically, Matsche found Atlantic sturgeon anesthetized with a 100 mg/L concentration of MS-222 experienced elevated cortisol levels at 2 and 24 hours after surgery; however, no differences in cortisol and plasma chemistry were found between resting fish and fish undergoing laparoscopy after surgical anesthesia was induced (250 mg/L and maintained with an 87.5 mg/L dose of MS-222).

Therefore, NMFS believes the use of higher concentrations of the anesthetic compound MS-222, for short-term durations, under constant observation by experienced researchers, is a safe procedure with manageable risks to the animals. Importantly, no other researchers than those designated on the permit would be authorized to perform laparoscopy without prior experience reported to NMFS-PR.

<u>*Blood Collection*</u>: Effects of drawing blood samples with syringes from the caudal vein of shortnose sturgeon could include pain, handling discomfort, possible hemorrhage at the site, or risk of infection. To mitigate these effects, the needle would be slowly advanced while applying gentle negative pressure to the syringe until blood freely flows into the syringe. Once blood is collected, direct pressure would be applied to the site to ensure clotting and prevent subsequent blood hemorrhaging (Stoskopf, 1993). The site would then be disinfected and checked again after recovery prior to release. Additionally, the project staff responsible for obtaining these samples would have received extensive experience in the procedure. Drawing blood in the manner described,

appears to have little probability of injuring or killing shortnose sturgeon or producing sub-lethal effects.

4.3 SUMMARY OF COMPLIANCE WITH APPLICABLE LAWS, NECESSARY FEDERAL PERMITS, LICENSES, AND ENTITLEMENTS

4.3.1 *Compliance with Endangered Species Act* (*ESA*):

4.3.1.1 *Consultations on Impacts on the Target Species under NMFS Jurisdiction*: To comply with Section 7 of the regulations governing takes of shortnose sturgeon (50 CFR 402.14(c)), a Section 7 consultation was initiated by the NMFS, Permits, Conservation and Education Division, Office of Protected Resources under the ESA. In accordance with Section 7 of the ESA of 1973, as amended (16 U.S.C. 1531 *et seq*.), a Biological Opinion was prepared by the NMFS' Endangered Species Division, Office of Protected Resources. It concluded, after reviewing the current status of shortnose sturgeon, the environmental baseline for the action areas, the effects of the take authorized in the permits, and the probable cumulative effects of the proposed permit, would not likely jeopardize the continued existence of shortnose sturgeon or any other NMFS ESA-listed species; nor would it likely destroy or adversely modify designated critical habitat.

4.3.1.2 *Consultations on Non-Target Species under USFWS Jurisdiction*: The USFWS was contacted by email with regard to potential impacts of the proposed activity on listed species (and/or habitats) under the USFWS's jurisdiction. UFWS biologist Mark Caldwell (USFWS, Ecological Services Office, Charleston, SC) concurred by letter (received January 19, 2011) with NMFS PR concluding the proposed action would not likely adversely affect the wood stork or other resources under the jurisdiction of the USFWS.

Additionally, Nicole Adimey, (USFWS; ES Office; Jacksonville, FL) was contacted separately by email regarding potential impacts of the proposed activity on endangered Florida manatee. Ms. Adimey agreed (by email dated January 11, 2011) with NMFS conclusion that the applicant's research as conditioned (see Section 4.5.8 of this EA) would not likely adversely affect this species; however, she suggested a minor change of a NMFS condition regulating unattended gill netting of sturgeon triggered by temperatures below 15°C. Specifically she suggested, because manatee are generally out of South Carolina by November and do not start migrating northward again into South Carolina waters until March, it would be more protective of manatee if nets could be unattended for 14 hours only between the months of November and March (instead of including NMFS conditions triggered by temperatures below 15°C). Based on this consultation, NMFS modified its condition adding the monthly interval when anchored gill nets would need to be attended if nets were set overnight for up to 14 hours below 15°C (See Section 4.5.1 of this EA).

4.3.2 *Compliance with the Magnuson-Stevens Fishery Conservation & Management Act*: NMFS PR contacted the Southeast Regional Office of Habitat Conservation (Beaufort Lab, Beaufort, NC) by email on January 3, 2011. The office concurred with NMFS PR on January 4, 2011 (by email from Fritz Rhode) that the proposed action using anchored and drift gill nets and trawls to capture shortnose sturgeon in South Carolina rivers would have minimal impacts on designated Essential Fish Habitat in these areas.

4.4 COMPARISON OF ALTERNATIVES

While the “no action” alternative would have no environmental effects, the opportunity to conduct this particular research would be lost. Initiation of this research would be important to collect information contributing to better understanding of shortnose sturgeon and providing information to NMFS needed to implement NMFS management activities if shortnose sturgeon are present in these river systems. This is important information that would help conserve and manage shortnose sturgeon as required by the ESA and implementing regulations.

The environmental effects of the preferred alternative would mainly be limited to individual shortnose sturgeon. However, effects would be minimal and this alternative would allow collection of valuable information assisting NMFS’ efforts to recover shortnose sturgeon. Neither option is expected to have adverse population nor stock-level effects on shortnose sturgeon. Given the preferred option’s minimal impact to the environment and the potential positive benefits of the research, NMFS believes the information gained would outweigh any likely negative effect to the target species.

4.5. MITIGATION MEASURES

4.5.1 *Capturing*:

- The Permit Holder must take all necessary precautions to ensure sturgeon are not harmed during capture, including use of appropriate net mesh size and twine preventing shutting gill opercula, restricting gill netting activities and decreasing the time of net sets.

- Location (GPS), temperature, dissolved oxygen., gear used for capture (e.g., mesh size, trawl, gill net, trammel), soak time, species captured, and any mortalities should be measured and recorded (at the depth fished) each time nets are set to ensure appropriate values according to the conditions below. This data must be made available to NMFS in annual reports or upon request.

- Gear must be deployed only in waters where D.O. levels ≥ 4.0 mg/L at the deepest depth sampled by the gear while deployed.

- Netting may take place between 0°C and 28 °C; however, if water temperature > 27°C, or is less than 7°C, sampling must be limited to non-invasive procedures (e.g., PIT and dart tag, measure, weigh, photograph, and genetic tissue clip).

- At water temperatures above 25°C to 28°C, nets may be set for up to one hour duration and are required to be tended.

- At water temperatures between 20°C ≤ 25°C, nets may be set for up to two hours duration and are required to be tended.

- At water temperatures between 15°C ≤ 20°C, nets may be set for up to four hours duration and are required to be tended.

- At water temperatures between $0 \leq 15°C$ (and between November and March), nets may be set while unattended for up to 14 hours duration in the Edisto River above river mile 40; however, at other locations and time periods between $0 \leq 15°C$, nets may be fished for up to10 hours, and must be tended in daylight hours.

- Trawls may be towed at an average speed of 3 to 5 mph and for no more than 10 minutes.

- A depth sounder/global positioning system must be used to monitor trawling position to minimize disturbance of the substrate while trawling. Trawls may not cover the same area within a 24 hour period. If a net or trawl becomes snagged (on bottom substrate, debris, etc.), it must be untangled immediately to reduce stress on the animals.

- Drift gill nets may be used drifting on the rising tide or in slack tide until just after high tide for approximately thirty minutes to approximately two hours, depending on the location and swiftness of the tide.

- All drift net sets must be tended continuously due to the risk of gear entanglement, interaction with other protected species or loss of gear resulting in ghost nets. Also, fishing gear must be pulled immediately if an obvious capture has been made.

4.5.2 *Holding and Handling*

- After removal from capture gear, researchers must hold sturgeon in floating net pens or in onboard live wells while shielding them from direct sunlight.

- To accommodate larger catches, if applicable, researchers must carry secondary net pen(s) in the research vessel; overcrowded fish must be transferred to the spare net pen or else released.

- Sturgeon overly stressed from capture (or captured > 27°C) must be resuscitated and allowed to recover inside a net pen or live well and released without further handling, with exception of PIT tagging, dart tagging, genetic tissue clip, weighing, measuring, and photographing.

- When fish are onboard the research vessel for processing, the flow-through holding tanks must allow for total replacement of water volume every 15 minutes. Backup oxygenation of holding tanks with compressed oxygen is necessary to ensure sturgeon do not become stressed and D.O. levels remain above saturation.

- The total handling time (includes onboard research procedures) must not exceed 20 minutes, unless fish have not recovered from anesthesia or a stressed condition.

- The total holding time of shortnose sturgeon after removal from the capture gear until returned to water must not exceed two hours, unless fish have not recovered from anesthesia or a stressed condition.

- The total holding of shortnose sturgeon when water temperature > 27°C, must never be longer than 30 minutes unless fish have not recovered from a stressed condition.

- Fish must be handled carefully and kept in water as much as possible during processing.

- During onboard handling, sturgeon must be supported using a sling or net, and handling should be minimized throughout the procedure.

- Smooth rubber gloves should be worn to reduce abrasion of skin and removal of mucus.

- Shortnose sturgeon (and bycatch) must be allowed to recover before released to ensure full recovery, and must be treated with an electrolyte bath prior to release to help reduce stress and restore slime coat.
- Sturgeon are extremely sensitive to chlorine; therefore, thorough flushing of holding tanks sterilized with bleach would be required between sampling periods.

4.5.3 *Egg/ Lavae Collection with Egg Mats*:

- Up to fifty eggs and/or larvae may be collected annually by artificial substrates in each of the Savannah River or Lake Marion and tributaries. Any additional eggs must be returned back to the site of collection.

- Eggs or larvae collected by substrate may be preserved and transported back to the lab.

- Once the total number of eggs and/or larvae authorized has been taken annually, artificial substrates must be removed from the river and sampling may not be resumed until the following year.

- All artificial substrates must be removed from the river upon completion of this project or by the expiration date of this permit, whichever comes first.

4.5.4 *Genetic Tissue Sampling:*

- Care must be used when collecting genetic tissue samples (soft fin clips). Instruments should be changed/disinfected and gloves changed between each fish sampled to avoid possible disease transmission or cross contamination of genetic material.

- Submission and archival of genetic tissue samples must be coordinated with Julie Carter (or current designated PI for Permit 13599) at the NOAA-NOS tissue archive in Charleston, SC between six and twelve months after collection ((843)762-8547).

- The Permit Holder may receive genetic material from the NOAA-NOS tissue archive for described research purposes by coordinating with Julie Carter (or otherwise the current designated PI Permit 13599), and the researcher(s) supplying the sample to the archive.

- The Permit Holder may not transfer biological samples to anyone not listed in the application without obtaining prior written approval from NMFS. Any such transfer will be subject to such conditions as NMFS deems appropriate.

- The terms and conditions concerning samples collected under this authorization will remain in effect as long as the material taken is maintained under the authority and responsibility of the Permit Holder.

4.5.5 *Tagging Conditions:*

- PIT tags must be used to individually identify all captured fish not previously tagged. Prior to placement of PIT tags, the entire surface of each fish must be scanned with PIT tag reader and visually inspected to ensure detection of fish tagged in other studies. Previously PIT-tagged fish must not be retagged.

- Researchers must not insert PIT or dart tags or perform other surgical procedures on juvenile shortnose sturgeon less than 300 mm in length.

- PIT tags should be injected in the left, dorsal musculature just anterior to the dorsal fin with the copper antenna oriented up, and then scanned after implantation ensuring proper tag function. PIT tags may also be inserted under the forth dorsal scutes after discussing with NMFS.

- When implanting numbered dart tags, they should be anchored in the dorsal fin base, inserted forwardly and slightly downward from the left side to the right anchored in the dorsal pterygiophores.

- The rate of PIT tag and dart tag retention on recaptured sturgeon, as well as the condition of fish at the site of tag injection, must be documented during the study and results reported to NMFS in annual and final reports.

- Surgical implantation of internal acoustic tags must only be attempted in water temperatures between 7°C and 27°C, when fish are in excellent condition, and must not be attempted with pre-spawning fish during spring on the spawning run.

- Between tagging or surgical procedures, instruments must be either sterilized or changed.

- To ensure proper closure of surgical incisions, a single uninterrupted suturing technique should be applied.

- The total weight of all tags must not exceed 2% of the sturgeon's total body weight unless otherwise authorized by the Permits Divsion.

4.5.6 *Anesthetization*:

- When preparing fresh solutions of MS-222 daily to anesthetize shortnose sturgeon, researchers must saturate them with dissolved oxygen and buffer them to a neutral pH using sodium bicarbonate.

- Researchers newly performing anesthesia on shortnose sturgeon must have first received supervised training on shortnose sturgeon or another surrogate species before doing so. The Responsible Party or PI must report this training to NMFS prior to the activity.

- Researchers may use MS-222 at concentrations up to 150 mg/L when anesthetizing shortnose sturgeon for implanting acoustic transmitters; and may use up to 250 mg/L when anesthetizing shortnose sturgeon for laparoscopic examinations.

- When anesthetizing shortnose sturgeon, researchers must observe fish closely to establish the proper level of anesthesia, and use a heart monitor when using concentrations of MS-222 above 150 mg/L.

- Should a researcher while performing a surgical procedure encounter a sudden reflex reaction from an anesthetized fish, the procedure should be stopped and the level of anesthesia reevaluated before proceeding.

- Only non-stressed animals in good condition can be anesthetized for a surgical procedure.

- To avoid injury to anesthetized sturgeon, researchers must use restraint (e.g., netting) preventing animals from jumping or falling out of the bath solutions.

- Researchers must observe shortnose sturgeon closely during anesthetic recovery; and prior to release to their environment, sturgeon must be fully recovered.

- All researchers should wear protective clothing, gloves, and goggles when handling MS-222 powder.

- Unused MS-222 solutions must be disposed of safely using state adopted procedures.

4.5.7. *Laparoscopic Examination, Gonad Biopsy and Blood Collection*:

- Researchers newly performing laparoscopy (and the associated gonad biopsy and blood collection) on shortnose sturgeon must have first received supervised training on shortnose sturgeon or another surrogate species before doing so. The Responsible Party or PI must report this training to NMFS prior to the activity.

- Should uncontrolled hemorrhaging occur while performing laparoscopy, the procedure should be stopped and the bleeding stabilized before deciding to proceed, else stopping.

- Blood and biopsy samples may be sent for analyses to Mark Matsche at the Maryland DNR, Oxford Maryland Laboratory; blood samples may also be sent to the Antech Diagnostics Laboratory, Lake Success, New York.

- Blood and biopsy samples not consumed during testing, must be properly disposed of immediately after all testing is completed.

4.5.8 *Endangered Florida Manatee Interaction*: The following conditions are provided by the USFWS to limit interactions and avoid injury to endangered Florida manatee:

(1) Methods to avoid capture of Florida manatee:

- Vessel personnel must be informed it is illegal to intentionally or unintentionally harm, harass, or otherwise "take" manatees, and to obey all posted manatee protection speed zone, Federal manatee sanctuary and refuge restrictions, and other similar state and local regulations while conducting in-water activities. Such information shall be provided in writing to all vessel personnel prior to beginning the permitted research.

- Crew involved in research activities must wear polarized sunglasses to reduce glare while on the water and keep a look out for manatee. The crew shall include at least one member dedicated to watching for manatee during all in-water activities.

- All vessels engaged in netting and trapping shall operate at the slowest speed consistent with those activities.

- Rope attaching floats to nets should not have kinks or contain slack that could present an entanglement hazard to manatee.

- All nets must be continuously monitored. Netting activities must cease if a manatee is sighted within a 100-foot radius of the research vessel or the net, and may resume only when the animal is no longer within this safety zone, or 30 minutes has elapsed since the manatee was last observed within the safety zone.

(2) Methods to avoid injury if a manatee is captured:

- Devote all research staff efforts to freeing the animal. Remember that a manatee must breathe and surface approximately every 4 minutes. The PI must brief all research participants to ensure that they understand that freeing a manatee can be dangerous. This briefing will caution people to keep fingers out of the nets, that no jewelry should be worn, that they be careful to stay away from the manatee's paddle, and that they give the animal adequate time and room to breathe as they are freeing it.

- As appropriate, turn off the vessel or put engine in neutral to avoid injury.

- Release tension on the net to allow the animal the opportunity to free itself. Exercise caution when attempting to assist the animal in freeing itself. Manatees are docile animals but can thrash violently if captured or become entangled in a net. A 1,200 to 3,500 pound manatee can cause extensive damage to nets while trying to escape or breathe, so quick action is essential to protect both the manatee and the net. Ensure that the animal does not escape with net still attached to it.

- For immediate assistance with a captured animal, contact the South Carolina Marine Mammal Stranding Program 800-922-5431. Also, to report any gear or vessel interactions, or sighting of manatees, contact Nicole Adimey (USFWS) at 904-731-3079 (weekdays); 904-655-0730 (cell); fax 904-731-3045. Also contact NMFS, Chief, Permits, Conservation and Education Division at 301-713-2289 as soon as possible.

- Interactions with manatee should be documented with location, date, estimated size, water & air temp, any scar patterns and photos if possible (See Appendix 4: Manatee Sighting Report)

4.5.9 *Sea Turtles*: Although the potential for encountering a sea turtle during netting is discounted, the following standard condition was suggested by the NMFS SEFSC to address how researchers would handle/resuscitate a sea turtle.

- If a sea turtle is incidentally encountered during research, the Permit Holder, Principal Investigator, Co-investigator(s), or Research Assistant(s) acting on the Permit Holder's behalf must use care when handling a live turtle to minimize any possible injury; and appropriate resuscitation techniques must be used on any comatose turtle prior to returning it to the water. All turtles must be handled according to procedures specified in 50 CFR 223.206(d)(1)(i).

4.5.10 *Bottlenose Dolphin:* The following measures were included to suggest means to minimize interactions with bottlenose dolphins.

- Nets must not be deployed if a dolphin is sighted within the action area unless it is seen on a path away from the netting area.

- A standard pre-net set monitoring period of 30 minutes shall be used ensuring no dolphins are in the area.

- Once deployed where dolphin are present, the nets must be observed at all times; -- “net observing” defined as continual, complete, and thorough visual check of nets at all times while set.

- Should any dolphin enter the research area after the nets are set, the lead line must be raised and dropped in an attempt to make dolphins in the vicinity aware of the net. However, no attempt should be made to harass the animal, and they should be allowed to leave on their own.

- Nets must be removed should the animals not leave the area, and must not be reset until the dolphin(s) have departed the area and/or have not been seen for 15 minutes.

- To report (and for immediate assistance with) a captured dolphin, contact the South Carolina Marine Mammal Stranding Program 800-922-5431.

- In all boating activities — including travel to acoustic receiver arrays outside of the netting area — researchers are advised to keep a close watch for marine mammals to avoid harassment or interaction and also to review the NMFS Guidelines for Viewing Marine Mammals (http://www.nmfs.noaa.gov/pr/education/regional.htm)

4.5.11 *Atlantic Sturgeon Interaction*:

- If an Atlantic sturgeon is incidentally captured, NMFS requests it be handled as recommended by NOAA sturgeon research protocols (Kahn and Mohead 2010) and minimally PIT tagged, dart tagged, genetically sampled, and released.

- If a listing for Atlantic sturgeon occurs during the permitted time frame authorized for shortnose sturgeon research, the researcher would be required to consult with NMFS for coverage of any incidental takes of Atlantic sturgeon before proceeding with research.

- NMFS requests Atlantic sturgeon interactions to be reported to Lynn Lankshear, NMFS PR at 978-281-9300 x 6535; (Lynn.Lankshear@noaa.gov). This report should contain descriptions of take, including lethal take, location, and final disposition of the sturgeon. Specimens or body parts of dead Atlantic sturgeon should be preserved (preferably on ice or refrigeration) until sampling and disposal procedures are discussed with NMFS.

4.5.12 *Aquatic Nuisance Species*:

- To prevent potential spread of aquatic nuisance species identified in the watershed, all equipment assigned to the research must not be reassigned to other watersheds until gear and equipment used is sanitized, rinsed, and air dried.

4.5.13 *Incidental Mortality of Shortnose Sturgeon*:

- If a greater incidence of mortality or serious injury should occur than is authorized, NMFS PR would need to be consulted to determine the cause of mortality and to discuss any remedial changes in research methods. The Permits Division could grant authorization to resume permitted activities based on review of the incident depending on the circumstances, or else suspend activities.

4.6 UNAVOIDABLE ADVERSE EFFECTS

The measures required by permit conditions are intended to reduce, to the maximum extent practical, the potential for adverse effects of the research on all species. However, because the research involves wild animals not accustomed to being captured, the research activities would unavoidably result in harassment.

The research activities would cause unavoidable disturbance, stress, and minor injury to the captured shortnose sturgeon and other non-target species (temporarily interrupting normal activities such as feeding). The proposed research could also have some incidental sub-lethal effects on some individuals based on planned invasive surgery and schedule of netting over five years. However, mortality is anticipated or authorized and these risks are not expected to have long-term effects on target or non-target individuals or populations.

4.7 CUMULATIVE EFFECTS

In addition to the direct and indirect effects assessed above, in accordance with NEPA, this EA considers the potential for cumulative effects. Cumulative effects are those that result from incremental impacts of a proposed action which when added to other past, present, and reasonably foreseeable future threats or actions, regardless of which agency (federal or nonfederal) or person(s) undertakes such actions. Cumulative impacts can result from individually minor but collectively significant actions that take place over a period of time. For shortnose sturgeon range-wide, these effects include: research, bycatch, poaching, artificial propagation, dams, dredging, blasting, water quality and contaminants.

4.7.1 *Other Shortnose Sturgeon Research Permits*:

Shortnose sturgeon have been the focus of field studies since the 1970s. The primary purpose of this research is for monitoring populations and gathering data for physiological, behavioral and ecological studies. Over time, NMFS has issued dozens of permits for takes of shortnose sturgeon within its range for a variety of activities including capture, handling, lavage, laparoscopy, bloodwork, habitat, spawning verification, genetics, aging, and tracking. Research on shortnose sturgeon in the U.S. is carefully controlled and managed so it does not operate to the disadvantage of the species. As such, all scientific research permits are also conditioned with mitigation measures to ensure that the research impacts target and non-target species as minimally as possible.

Range wide, there are currently 17 active scientific research permits targeting wild shortnose sturgeon populations with similar objectives as proposed by the applicant (See Appendix 1) these include Permit 1505-01, the ESA permit authority the applicant currently operates under. There are also three other currently authorized research projects studying the unlisted Atlantic sturgeon and shortnose sturgeon populations in South Carolina waters, each potentially impacting shortnose sturgeon and its habitat to some extent. Permits 1542 and 1543 are held by SCANA, Inc. and Duke Energy Company, respectively, located in the upper Santee Basin. The third permit is Permit 1447 held by the South Carolina DNR researching shortnose and Atlantic sturgeon in some of the same coastal rivers as requested by the applicant. A Biological Opinion was issued for each of these the permits appearing in Appendix A, including the requirement for consideration of cumulative effects to the species. For each permit, the Biological Opinion concluded that issuance, as conditioned, was not likely to jeopardize the continued existence of the shortnose sturgeon, either individually or cumulatively.

4.7.2 *Bycatch and Poaching*:

4.7.2.1 <u>*Bycatch*</u>:

Directed harvest in commercial fisheries of both shortnose and Atlantic sturgeon is prohibited. In 1998, the Atlantic States Marine Fisheries Commission (ASMFC) imposed a coast-wide fishing moratorium on Atlantic sturgeon until 20 year classes of adult females could be established (ASMFC 1998). NMFS followed this action by closing the Exclusive Economic Zone (EEZ) to Atlantic sturgeon take in 1999. Shortnose sturgeon has also likely benefited from this closure as any bycatch in the fishery targeting Atlantic sturgeon (primarily for meat since the 1950s) has been eliminated.

Although directed harvest of shortnose sturgeons has been prohibited since 1967, bycatch of this species has been documented in other state sponsored fisheries throughout its range. Adults are believed to be especially vulnerable to fishing gears for other anadromous species (such as shad, striped bass and herring) during times of extensive migration – particularly the spawning migration upstream, followed by movement back downstream (Litwiler 2001). Additionally, bycatch in the southern trawl fishery for shrimp *Penaeus* spp. was estimated at 8% in one study (Collins *et al*. 1996).
The 1998 Recovery Plan for shortnose sturgeon lists commercial and recreational shad fisheries as a source of shortnose bycatch. Although shortnose sturgeon are primarily captured in gill nets, they have also been documented with pound nets, fyke/hoop nets, catfish traps, shrimp trawls and hook and line fisheries (recreational angling).

Bycatch in the gill net fisheries can be quite substantial and is believed a significant threat to the species. The catch rates in drift gill nets are believed to be lower than for fixed nets; longer soak times of the fixed nets appear to be correlated with higher rates of mortalities. In an American shad gill net fishery in South Carolina, of 51 fish caught, 16% were bycatch mortality and another 20% of the fish were visibly injured when nets were not checked for longer periods (Collins *et al*. 1996).

4.7.2.2 Poaching:

There is evidence of shortnose sturgeon targeted by poachers throughout their range, and particularly where they appear in abundance (such as on the spawning grounds) but the extent this is occurring is difficult to assess (Dadswell 1979, Dovel *et al*. 1992, Collins *et al*. 1996). There have been several documented cases of shortnose sturgeon caught by recreational anglers. One shortnose sturgeon illegally taken on the Delaware River was documented by a New Jersey Department of Fish and Wildlife conservation officer in Trenton New Jersey (NJCOA 2006). Additionally, citations have been issued for illegal recreational fishing of shortnose in the vicinity of Troy, New York on the Hudson River and on the Cooper River in South Carolina. Poaching has also been documented for other sturgeon species in the United States. Cohen (1997) documented poaching of Columbia River white sturgeon sold to buyers on the U.S. east coast. Poaching of Atlantic sturgeon has also been documented by law enforcement agencies in Virginia, South Carolina and New York and is considered a potentially significant threat to the species, but the present extent and magnitude is largely unknown (ASPRT 1998).

4.7.3 *Artificial Propagation*:

Since there are aquaculture or research facilities currently raising captive shortnose sturgeon on watersheds of native shortnose sturgeon, there is a potential for escapement and impact to the wild population. Potential threats from aquaculture escapement include the genetic alterations to native populations and potential competition for space and resources between hatchery-reared and wild fish. Further, since most sturgeon diseases have been documented in captive-reared fish, there is also the chance that escapees could spread pathogens and disease. To date, there have been no reports of escapees from the two facilities in Canada or from the USFWS facilities in South Carolina and Georgia. However, on the Connecticut River six fish artificially spawned from adults captured at Holyoke were released with radio tags upstream of the Holyoke Dam in 1989 and 1990 and they were subsequently never recovered. Additionally, several juveniles were accidentally released in 2006 and unrecovered.

There are currently two private companies producing shortnose sturgeon in Canada. Both are located on the St. John River and one is currently operating at a commercial scale. In the United States, the USFWS has been raising shortnose sturgeon (NMFS Permit No. 1604) for approximately 28 years. Until recently Bears Bluff National Fish Hatchery located on Wadmalaw Island in South Carolina raised the bulk of these fish while some fish were also reared at the USFWS' Warm Springs, GA and Orangeburg, SC hatcheries. Propagation of shortnose sturgeon at the Bears Bluff facility ended in the spring of 2008 but a subset of the broodstock and offspring are still maintained at Warm Springs and Orangeburg.

Captive shortnose sturgeon are also maintained by the USGS at the Conte Anadromous Fish Research Center (Permit No. 1549) located on the Connecticut River. These stocks are held in quarantine and are primarily used as test animals for upstream and downstream fish passage studies, but some progeny are also made available to other research facilities and educational display aquaria when requested. The F-1 progeny are produced periodically using wild native fish from the Connecticut River in a *living stream* natural spawning environment; however, hatchery protocol is not a research objective at the facility.

4.7.4 *Dams*:

Dams are used to impound water for water resource projects such as hydropower generation, irrigation, navigation, flood control, industrial and municipal water supply, and recreation. Dams can have profound effects on diadromous fish species by fragmenting populations, eliminating or impeding access to historic habitat, modifying free-flowing rivers to reservoirs and altering downstream flows and water temperatures. Direct physical damage and mortality can occur to diadromous fish that migrate through the turbines of traditional hydropower facilities or as they attempt to move upstream using fish passage devices.

In addition to dams impeding anadromous fish migration and associated mortalities, Hill (1996) identified the following potential impacts from hydropower plants: altered DO concentrations; artificial destratification; water withdrawal; changed sediment load and channel morphology; accelerated eutrophication and change in nutrient cycling; and contamination of water and sediment. Furthermore, activities associated with dam maintenance, such as dredging and minor excavations along the shore, can release silt and other fine river sediments that can be deposited in nearby spawning habitat. Dams can also reduce habitat diversity by forming a series of homogeneous reservoirs; these changes generally favor different predators, competitors and prey, than were historically present in the system (Auer 1996a).

The effects of dams on populations of shortnose sturgeon are generally well documented (Kynard 1998, Cooke *et al.* 2004). However, there may be some rivers where shortnose sturgeon have been extirpated almost without notice due to the construction of impassable dams. In these rivers historical presence of shortnose sturgeon was likely, but unknown; there are historical accounts of sturgeon but it is unclear if both Atlantic and shortnose sturgeon used the river and if the river supported spawning of either species. For example, the Susquehanna River is the second largest river on the east coast of the U.S. and there are historical and anecdotal accounts of sturgeon upriver. Currently the Susquehanna has four mainstem dams, the lowermost of which is at approximately rkm 16. The dam has a fish lift but it is unusable by shortnose sturgeon. If the Susquehanna River once supported a population of shortnose sturgeon, it is no longer available to them.

Perhaps the biggest impact dams have on shortnose sturgeon is the loss of upriver spawning and rearing habitat. Migrations of shortnose sturgeon in rivers without barriers are wide-ranging with total distances exceeding 200 km or more depending on the river system (Kynard 1997). The construction of dams has blocked upriver passage for the majority of the shortnose sturgeon populations. Dams have restricted spawning activities to areas below the impoundment, often in close proximity to the dam (Kynard 1997, Cooke *et al*. 2004).

The suitability of riverine habitat for shortnose sturgeon spawning and rearing depends on annual fluctuations in flow, which can be greatly altered or reduced by the presence and operation of dams (Cooke *et al*. 2004). Effects on spawning and rearing may be most dramatic in hydropower facilities operating in peaking mode (Auer 1996a). Daily peaking operations store water above the dam when demand is low and release water for electricity generation when demand is high, creating substantial, daily fluctuations in flow and temperature regimes. Kieffer and Kynard (*in press*), have documented flow fluctuations for hydroelectric power generation affected access to spawning habitat and possibly deterred spawning of shortnose sturgeon on the Connecticut River. Similar results were reported in studies conducted for lake sturgeon *A. fulvescens* in the Sturgeon River, Michigan (Auer 1996b) and white sturgeon *A. transmontanus* in the Columbia River, Oregon and Washington (Parsley and Beckman 1994). Kieffer and Kynard (in review), have also observed flow regimes from an upstream hydroelectric facility that were either so forceful that they scoured the shortnose sturgeon rearing shoals or so low that the shoals were dry and exposed. Auer (1996b) demonstrated that there is greater spawning success of lake sturgeon on the Sturgeon River, MI, when facilities operated in the more natural "run-of-the-river" mode.

4.7.5 *Dredging and Blasting:*

4.7.5.1 Dredging:

Many rivers and estuaries are periodically dredged for flood control or to support commercial shipping and recreational boating. Dredging also aids in construction of infrastructure and in marine mining. Dredging may have adverse impacts on aquatic ecosystems including direct removal/burial of organisms; turbidity; contaminant resuspension; noise/disturbance; alterations to hydrodynamic regime and physical habitat and actual loss of riparian habitat (Chytalo 1996, Winger *et al.* 2000).

Dredges are generally either mechanical or hydraulic. Mechanical dredges are used to scoop or grab bottom substrate while removing hard-packed materials and debris. Mechanical dredge types are clamshell buckets; endless bucket conveyor, or single backhoe or scoop bucket types; however, such dredges have difficulty holding fine materials in the buckets and do not dredge continuously. Material excavated with mechanical dredges is often loaded onto barges for transport to a designated placement site (USACOE 2008).

Hydraulic dredges are used principally to dredge silt, sand and small gravel. Hydraulic dredges include cutterhead pipeline dredges and self-propelled hopper dredges. Hydraulic dredges remove material from the bottom by suction, producing slurry of dredged material and water, either pumped directly to a placement site, or in the case of a hopper dredge, into a hopper and later transported to a dredge spoil site. Cutterhead pipeline dredges can excavate most materials including some rock without blasting and can dredge almost continuously (USACOE 2008).

The impacts of dredging operations on sturgeon are often difficult to assess. Hydraulic dredges can lethally take sturgeon by entraining sturgeon in dredge drag arms and impeller pumps (NMFS 1998). Mechanical dredges have also been documented to lethally take shortnose sturgeon (Dickerson 2006). In addition to direct effects, indirect effects from either mechanical or hydraulic dredging include destruction of benthic feeding areas, disruption of spawning migrations, and deposition of resuspended fine sediments in spawning habitat (NMFS 1998). Another critical impact of dredging is the encroachment of low D.O. and high salinities upriver after channelization (Collins *et al.* 2001). Adult shortnose sturgeon can tolerate at least short periods of low D.O. and high salinities, but juveniles are less tolerant of these conditions in laboratory studies. Collins *et al*. (2001) concluded harbor modifications in the lower Savannah River have altered hydrographic conditions for juvenile sturgeon by extending high salinities and low D.O. upriver.

In addition to impacts of dredging, Smith and Clugston (1997) reported dredging and filling eliminates deep holes, and alter rock substrates. Nellis *et al.* (2007) documented dredge spoil drifted 12 km downstream over a 10 year period in the Saint Lawrence River, and those spoils have significantly less macrobenthic biomass compared to control sites. Using an acoustic trawl survey, researchers found Atlantic and lake sturgeon were substrate dependent and avoided spoil dumping grounds (McQuinn and Nellis, 2007). Similarly, Hatin *et al*. (2007) tested whether dredging operations affected Atlantic sturgeon behavior by comparing CPUE before and after dredging events in 1999 and 2000. The authors documented a three to seven-fold reduction in Atlantic sturgeon presence after dredging operations began, indicating sturgeon avoid these areas during operations.

4.7.5.2 *<u>Blasting</u>*:

Bridge demolition and other projects may include plans for blasting with powerful explosives. Fish are particularly susceptible to effects of underwater explosions and are killed over a greater range than other organisms (Lewis 1996). Unless proper precautions mitigate the damaging effects of shock wave transmission to physostomous fish like shortnose sturgeon, internal damage and/or death may result (NMFS 1998).

A study testing the effects of underwater blasting on juvenile shortnose sturgeon and striped bass was conducted in Wilmington Harbor, NC in December 1998, and January 1999 (Moser 1999). There were seven test runs including 32-33 blasts (3 rows with 10-11 blast holes per row and each hole ~ 10 ft apart) with about 24-28 kg explosives per hole. For each blast 50 hatchery reared shortnose sturgeon and striped bass were placed in cages three feet from the bottom at distances of 35, 70, 140, 280 and 560 ft upstream and downstream of the blast area. A control group of 200 fish was held 0.5 miles from the blast site (Moser 1999). Test blasting was conducted with and without an air curtain in-place 50 ft from the blast site. Survival was similar for both species. External assessments of impacts to the caged fish were conducted immediately after the blasts and 24 h later. After the 24 h period, a subsample of the caged fish, primarily from those cages nearest the blast, at 35 ft and some from 70 ft, were sacrificed for later necropsy.

Externally, shortnose sturgeon and striped bass selected for necropsy all appeared to be in good condition externally and behaviorally after blasts. However, results of necropsies found many had substantial internal injuries. Moser concluded many of the injuries would have resulted in eventual mortality (Moser 1999). Therefore, based on necropsy results, an apparent estimate of mortality was conducted finding that fish held in cages at 70 ft from blast sites were less seriously impacted by the test blasting than those held at 35 ft. Lastly, it was concluded shortnose sturgeon suffered fewer, less severe internal injuries than striped bass tested. For striped bass and shortnose sturgeon held in cages at 35 ft, approximately 66 and 12 percent, respectively, would have probably not survived the blasts due to their internal injuries. Also there appeared to be no reduction of injury in fish experiencing blasts while air curtains were in place

4.7.6 *Water Quality and Contaminants*:

The quality of water in river/estuary systems is affected by human activities conducted in the riparian zone and those conducted more remotely in the upland portion of the watershed. Industrial activities can result in discharges of pollutants, changes in water temperature and levels of D.O., and the addition of nutrients. In addition, forestry and agricultural practices can result in erosion, run-off of fertilizers, herbicides, insecticides or other chemicals, nutrient enrichment and alteration of water flow. Coastal and riparian areas are also heavily impacted by real estate development and urbanization resulting in storm water discharges, non-point source pollution, and erosion.

The water quality over the range of shortnose sturgeon varies by watershed but is notably poorer in the north than in the south. The U.S. Environmental Protection Agency (EPA) published its second edition of the National Coastal Condition Report (NCCR II) in 2005, a “report card” summarizing the status of coastal environments along the coast of the United States (USEPA 2005; See Table 7 below). The report analyzes water quality, sediment, coastal habitat, benthos, and fish contaminant indices to determine status. The northeast region and the Chesapeake Bay received grades of F. The Southeast region received an overall grade of B-, the best rating in the nation.

Table 7. Summary of the USEPA National Coastal Condition Report (NCCR II) for the U.S. east coast published by the U.S. Environmental Protection Agency (2005) grading coastal environments. (Northeast Region = ME through VA; southeast region = NC-FL; and the Chesapeake Bay = the central region).

	Region		
Status Index	**Northeast**	**Chesapeake Bay**	**Southeast**
Water Quality	D	F	B
Sediment	F	F	B
Coastal Habitat	B	-	C
Benthos	F	F	C
Fish Tissue	F	F	A
Overall	**F**	**F**	**B-**

Areas of concern having poor index scores were: 1) Hudson River – water quality, sediment, and tissue contaminants, 2) Delaware River – water quality and tissue contaminants, 3) Upper Chesapeake Bay – water quality and sediment, 4) Potomac River – sediment, 5) Pamlico Sound – water quality, 6) ACE Basin – water quality, and 7) St. Johns River – sediment. There was also a mixture of poor benthic scores scattered along the Northeast and Southeast region.

Although the south region scored fairly well in water quality, low D.O. and high temperature may limit available habitat and survival of juveniles. Secor (1995) noted a correlation between low numbers of sturgeon during this century and decreasing water quality caused by increased nutrient loading and increased spatial and temporal frequency of hypoxic water. Further, Secor and Gunderson (1998) and Collins *et al* (2001) hypothesized survival of juvenile sturgeon in estuaries may be compromised due to combined effects of increased hypoxia and temperature in nursery areas impacted by human activity. Hypoxia affects sturgeon species more than other fish species due to their limited ability to oxyregulate at low D.O. (Secor and Gunderson 1998;Secor 2002).

Sturgeon's first year of life may leave it particularly susceptible to low D.O. at early life stages and the limited means to escape from hypoxic waters (Secor and Niklitschek 2002). Niklitschek (2001) modeled suitable habitat availability for juvenile shortnose and Atlantic sturgeon in the Chesapeake Bay using a multivariable bioenergetics and survival model. Results show the cumulative stresses of hypoxia, high temperatures and salinity during summer months caused large reductions in potential nursery habitat for both species during 1990-1999 (Niklitschek 2001). The modeling established during dry years, when persistent hypoxia in deeper areas consistently precluded access to thermal refuges, there may little suitable habitat for juvenile sturgeon.

The EPA adjusted open water minimum D.O.-criteria for the Chesapeake Bay (increased from ~2 ppm to 3.5 mg/L) to provide protection specifically for sturgeon species, requiring higher levels of D.O. than other fish species (USEPA 2003). Niklitschek and Secor (2005) modeled the achievement of EPA's D.O. criteria for Atlantic sturgeon predicting available habitat for Atlantic sturgeon would increase by 13% per year, while an increase of water temperature by 1°C would reduce available habitat by 65%. Similar results may occur for sturgeons in southern rivers where high water temperatures and low D.O. are a common occurrence during the summer months.

Life history of shortnose sturgeon (i.e., long lifespan, extended residence in estuarine habitats, benthic foraging) predispose them to long-term, repeated exposure to environmental contamination and potential bioaccumulation of heavy metals and other toxicants (Dadswell 1979, NMFS 1998). However, there has been little work on the effects of contaminants on shortnose sturgeon to date.

Chemicals and metals such as chlordane, dichlorodiphenyl dichloroethylene (DDE), DDT, dieldrin, PCBs, cadmium, mercury, and selenium settle to the river bottom and are later consumed by benthic feeders, such as macroinvertebrates, and then work their way higher into the food web (e.g. to sturgeon). Some of these compounds may affect physiological processes and impede a fish's ability to withstand stress, while simultaneously increasing the stress of the surrounding environment by reducing D.O., altering pH, and altering other physical properties of the water body.

Although there have been very few analyses of shortnose sturgeon tissues for contaminants, shortnose sturgeon collected from the Delaware and Kennebec rivers had total toxicity equivalent concentrations of polychlorinated dibenzo-p-dioxins (PCDDs), polychlorinated dibenzofurans (PCDFs), PCBs, DDE, aluminum, cadmium, and copper above adverse effect concentration levels reported in the literature (ERC 2002, 2003). In the Hudson, six fish have been tested over the past 37 years. Most fish carried very high burden load of PCBs, or one of its derivatives (DDT). Dioxin and furans were detected in ovarian tissue from shortnose sturgeon caught in the Sampit River/Winyah Bay system (SC). Results showed that four out of seven fish tissues analyzed contained tetrachlorodibenzo-*p*-dioxin (TCDD) concentrations greater than 50 pg/g (parts-per-trillion), a level which can adversely affect the development of sturgeon fry (J. Iliff, NOAA Habitat Restoration Division, Silver Spring, MD, unpublished data).

Heavy metals and organochlorine compounds accumulate in sturgeon tissue, but their long-term effects are not known (Ruelle and Henry 1992, Ruelle and Keenlyne 1993). High levels of contaminants, including chlorinated hydrocarbons, in several other fish species are associated with reproductive impairment (Cameron *et al*. 1992, Longwell *et al*. 1992, Hammerschmidt *et al*. 2002, Giesy *et al*. 1986, Mac and Edsall 1991, Matta *et al*. 1998, Billsson *et al*. 1998), reduced survival of larval fish (Berlin *et al*. 1981, Giesy *et al*. 1986), delayed maturity (Jorgensen *et al*. 2004) and posterior malformations (Billsson *et al*. 1998). Pesticide exposure in fish may affect anti-predator and homing behavior, reproductive function, physiological maturity, swimming speed and distance (Beauvais *et al*. 2000, Scholz *et al*. 2000, Moore and Waring 2001, Waring and Moore 2004). Sensitivity to environmental contaminants also varies by life stage.

Early life stages of fish appear to be more susceptible to environmental and pollutant stress than older life stages (Rosenthal and Alderdice 1976). Dwyer *et al*. (2005) compared the relative sensitivities of common surrogate species used in contaminant studies to 17 listed species including shortnose and Atlantic sturgeons. The study examined 96-hour acute water exposures using early life stages where mortality is an endpoint. Chemicals tested were carbaryl, copper, 4-nonphenol, pentachlorophenal (PCP) and permethrin. Of the listed species, Atlantic and shortnose sturgeon were ranked the two most sensitive species tested (Dwyer *et al*. 2005). Additionally, a study examining the effects of coal tar, a byproduct of the process of destructive distillation of bituminous coal, indicated that components of coal tar are toxic to shortnose sturgeon embryos and larvae in whole sediment flow-through and coal tar elutrtraite static renewal (Richland *et al*. 1993).
Lastly, the operation of power plants can have unforeseen and detrimental impacts to water quality which can affect shortnose sturgeon. For example, the St. Stephen Power Plant near Lake Moultrie, South Carolina was shut down for several days in June 1991 when large mats of aquatic plants entered the plant's intake canal and clogged the cooling water intake gates (Balciunas *et al.* 2002). Decomposing plant material in the tailrace canal coupled with the turbine shut down (allowing no flow of water) triggered a low D.O. water condition downstream and a subsequent fish kill. The South Carolina Wildlife and Marine Resources Department reported that twenty shortnose sturgeon were killed during this low D.O. event.

4.7.7 *Summary of Cumulative Impacts*:

Effects of past and ongoing human and natural factors and current threats (fisheries, water quality, dredging, dams, existing NMFS research permits, and other actions) are occurring (or have occurred) in or near the action area that have contributed to the current status of the species, are described above, and are also included in the baseline section of the Biological Opinion issued for this proposed research activity. These activities and threats are expected to continue into the future.

Overall, the preferred alternative would not be expected to have more than short-term effects on shortnose sturgeon if sturgeon are present in the research locations. The impacts of the non-lethal research activities are not expected to have more than short-term effects on individual animals and any increase in stress levels from the capture and handling would dissipate rapidly. Even if an animal was exposed to additional capture (e.g., a week later), no significant cumulative effects from the research itself would be expected given the nature of the effects. Based on the analysis in this EA and supported by the Biological Opinion, NMFS expects the proposed authorization of shortnose sturgeon research activities of the preferred alternative would not appreciably reduce the species likelihood of survival and recovery in the wild nor would it adversely affect spawning, mortality rates, or recruitment rates. In particular, NMFS expects the proposed research activities not to affect adult reproductive adults in a way that appreciably reduces their reproductive success, the survival of young, or the number of young that annually recruit into the breeding populations.

The incremental impact of the proposed research on these animals, when added to other past, present, and reasonably foreseeable future actions discussed here, would not be significant at an individual or a population level. Therefore, no species level events would result from the capture, handling, and release of shortnose sturgeon. The data collected during sampling activities linked with the proposed action would help assess movement and habitat use of juvenile shortnose sturgeon found in the South Carolina river waters. The research would provide information helpful in managing, conserving, and recovering this species and would outweigh any adverse impacts.

Moreover, the Biological Opinion prepared for File No. 15677 provides an integration and synthesis of the information about the status of the species, past and present activities affecting the species, possible future actions that might affect the species, and effects of the proposed action to provide a basis for determining the additive effects of the take authorized in this permit on ESA listed sturgeon, in light of their present and anticipated future status. The conclusion of the biological opinion for File No. 15677 was the proposed action would not likely jeopardize the continued existence of the species.

The opinion also concluded NMFS is not aware of any future State, tribal, local, or private actions in the action area that may have a bearing on the risk assessment, and finds that the that the issuance of the proposed permit would have only negligible impacts to shortnose sturgeon. The analysis of past, present and reasonably foreseeable actions indicates no cumulatively significant impacts would occur associated with the proposed action.

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U.S. Fish and Wildlife Service Northern Florida Field Office 7915 Baymeadows Way, Suite 200 Jacksonville, Florida 32256-7517	ESA non-target species Section 7 informal consultations
Habitat Conservation Division NMFS Southeast Regional Office Beaufort, NC 28516	Informal consultations on effects on EFH of federally managed species

LITERATURE CITED

Adams, S. M., A. M. Brown, and R. W. Goede. 1993. A quantitative health assessment index for rapid evaluation of fish condition in the field. Trans. Am. Fish. Soc. 122:63-73.

Atlantic Sturgeon Plan Recovery Team (ASPRT). 1998. Amendment 1 to the Interstate Fishery Management Plan for Atlantic Sturgeon. Atlantic States Marine Fisheries Commission, Washington, D.C. Fishery Management Report No. 31:1-43.

ASMFC 1998. Amendment 1 to the interstate fishery management plan for Atlantic sturgeon. Management Report No. 31, 43 pp.

Atlantic Sturgeon Plan Recovery Team (ASPRT). 1998. Amendment 1 to the Interstate Fishery Management Plan for Atlantic Sturgeon. Atlantic States Marine Fisheries Commission, Washington, D.C. Fishery Management Report No. 31:1-43.

Auer, N. A. 1996a. Importance of habitat and migration to sturgeons with emphasis on lake sturgeon. *Canadian Journal of Fisheries and Aquatic Sciences* 53(S1): 152-160.

Auer, N. A. 1996b. Response of spawning lake sturgeons to change in hydroelectric facility operation. *Transactions of the American Fisheries Society* 125: 66-77.

Bain, M. B. 1997. Atlantic and shortnose sturgeons of the Hudson River: Common and Divergent Life History Attributes. *Environmental Biology of Fishes* 48: 347-358.

Balciunas F.K., M. J. Grodowitz, A.F Cofrancesco, J.F. Shearer. 2002. Hydrilla. *In*: Van Driesche, R., *et al.*, 2002, Biological Control of Invasive Plants in the Eastern United States, USDA Forest Service Publication FHTET-2002-04, 413 p.

Beauvais, S.L., S.B. Jones, S.K. Brewer, and E. E. Little. 2000. Physiological measures of neurotoxicity of diazinon and malathion to larval rainbow trout (*Oncorhynchus mykiss*) and their correlation with behavioral measures. *Environmental Toxicology and Chemistry* 19: 1875-1880.

Berlin, W.H., R.J. Hesselberg, and M.J. Mac. 1981. Chlorinated hydrocarbons as a factor in the reproduction and survival of Lake Trout (*Salvelinus namaycush*) in Lake Michigan. Technical Paper 105, U.S. Fish and Wildlife Service. 42 pp.

Billsson,K., L.Westerlund, M.Tysklind, and P.Olsson. 1998. Developmental disturbances caused by polychlorinated biphenyls in zebrafish (*Brachydanio rerio*).*Marine Environmental Research* 46: 461-464.

Brännäs, E., H. Lundqvist, E. Prentice, M. Schmitz, K. Brännäs and B. Wiklund. 1994. Use of the passive integrated transponder (PIT) in a fish identification and monitoring system for fish behavioral studies. Transactions of the American Fisheries Society Symposium 123:395-401.

Brown L.A. 1988. Anesthesia in fish. *In:* Veterinary Clinics of North America: *Small Animal Practice,* 1988, vol 18, pp. 317-330.

Cameron, P. J. Berg, V. Dethlefsen and H.Von Westernhagen. 1992. Developmental defects in pelagic embryos of several flatfish species in the southern North Sea. *Netherlands Journal of Sea Research* 29(1-3):239-256.

Chytalo, K. 1996. Summary of Long Island Sound dredging windows strategy workshop. In: Management of Atlantic Coastal Marine Fish Habitat: Proceedings of a Workshop for Habitat Managers. ASMFC Habitat Management Series #2.

Clugston, J.P. 1996. Retention of T-bar anchor tags and passive integrated transponder tags by gulf sturgeon. North American Journal of Fisheries Management 16:682-685.

Cohen, A. 1997. Sturgeon poaching and black market caviar: a case study. *Env. Biol. Fish*. 48:423-426.

Collins, M.R., T.I.J. Smith, and L.D. Heyward. 1994. Effectiveness of six methods for marking juvenile shortnose sturgeon. Progressive Fish Culturist 56:250–254.

Collins, M.R., S.G. Rogers, and T.I.J. Smith. 1996. Bycatch of sturgeons along the southern Atlantic coast of the USA. *North American Journal of Fisheries Management* 16:24-29.

Collins, M.R. and T.I.J. Smith. 1997. Distributions of shortnose and Atlantic sturgeons in South Carolina. North Amer. Jour. of Fish. Man. 17:995-1000.

Collins, M.R., S.G. Rogers, T.I.J. Smith, and M.L. Moser. 2000. Primary factors affecting sturgeon populations in the southeastern United States: fishing mortality and degradation of essential habitats. *Bulletin of Marine Science* 66(3):917-928.

Collins, M.R., W.C Post, and D.C. Russ. 2001. Distribution of Shortnose Sturgeon in the Lower Savannah River. Final Report to the Georgia Ports Authority, 2001. 21pp.

Collins, M. R., Cooke, D., Post, B., Crane, J., Bulak, J., Smith, T.I.J., Greig, T.W., and J.M. Quattro. 2003. Shortnose Sturgeon in the Santee-Cooper Reservoir System, South Carolina. Trans. Amer. Fish. Soc. 132:1244-1250.

Cooke, D.W., S.D. Leach and J. Isely. 2002. Behavior and lack of upstream passage of shortnose sturgeon at a hydroelectric facility/navigation lock complex. Pages 101-110. In: Biology, management, and protection of North American sturgeon, W. Van Winkle, P.J. Anders, D.H. Anders, D.H. Secor and D.A. Dixon, editors. American Fisheries Society, Symposium 28. Bethesda, Maryland.

Cooke, D.W., J.P. Kirk, J.V. Morrow, Jr., and S.D. Leach. 2004. Population dynamics of a migration limited shortnose sturgeon population. *Proceedings of the Annual Conference, Southeastern Association of Fish and Wildlife Agencies* 58:82-91.

Coyle, S.D., Durborow, R.M., and Tidwell, J.H. 2004. Anesthetics in aquaculture. SRAC, Nov 2004., Publication No. 3900; 6 pp.

Dadswell, M.J. 1979. Biology and population characteristics of the shortnose sturgeon, *Acipenser brevirostrum* LeSueur 1818 (*Osteichthyes: Acipenseridae*), in the Saint John River estuary, New Brunswick, Canada. *Canadian Journal of Zoology* 57:2186-2210.

DeVries, R.D. 2006. Population dynamics, movments, and spawning habitat of the shortnose sturgeon, *Acipenser brevirostrum*, in the Altahmha River System, Georgia. (MS Thesis) University of Georgia; 103pp.

Dickerson, D. 2006. Observed takes of sturgeon and turtles from dredging operations along the Atlantic Coast. Supplemental data provided by U.S. Army Engineer R&D Center Environmental Laboratory, Vicksburg, Mississippi.

Dovel, W.L., A.W. Pekovitch, and T.J. Berggren. 1992. Biology of the shortnose sturgeon (*Acipenser brevirostrum* Lesueur, 1818) in the Hudson River estuary, New York. Pages 187-216 *in* C.L. Smith (Ed) Estuarine Research in the 1980s. State University of New York Press, Albany, New York.

Duke Power. 2004. Catawba-Wateree Hydro Project Study Plan: Diadromous Fish Studies. Duke Power Company, Charlotte, North Carolina. (Last revised 05/25/2006).

Dwyer, F. J., D. K. Hardesty, C. E. Henke, C. G. Ingersoll, D. W. Whites, T. Augspurger, T. J. Canfield, D. R. Mount, and F. L. Mayer. 2005. Assessing contaminant sensitivity of endangered and threatened aquatic species: part III. Effluent toxicity tests. Archives of Environmental Contamination and Toxicology 48: 174-183.

Environmental Research and Consulting, Inc. (ERC). 2002. Contaminant analysis of tissues from two shortnose sturgeon (Acipenser brevirostrum) collected in the Delaware River. Prepared for National Marine Fisheries Service. 16 pp. + appendices.

Environmental Research and Consulting, Inc. (ERC). 2003. Contaminant analysis of tissues from a shortnose sturgeon (Acipenser brevirostrum) from the Kennebec River, Maine. Report submitted to National Marine Fisheries Service, Protected Resources Division, Gloucester, MA. 5 pp.

Everman, B.W., and B.A. Bean. 1898. Indian River and its fishes. Report of United States Fisheries Commission 1896:227-248.

Fox, D. A., J. E. Hightower, and F. M. Parauka. 2000. Gulf Sturgeon spawning migration, and habitat in the Choctawhatchee River System, Alabama-Florida. Transactions of the American Fisheries Society 129:811-826.

Giesy, J.P., J. Newsted, and D.L. Garling. 1986. Relationships between chlorinated hydrocarbon concentrations and rearing mortality of chinook salmon (*Oncorhynchus tshawytscha*) eggs from Lake Michigan. Journal of Great Lakes Research 12(1):82-98.

Gutreuter, S., R. Burkhardt, and K. Lubinski. 1995. Long Term Resource Monitoring Program Procedures: fish monitoring. Long Term Resource Monitoring Program Report 95-P002-1. National Biological Center, Environmental Technical Center, Onalaksa, Wisconsin.

Hammerschmidt C.R., Sandheinrich M.B., Wiener J.G., Rada R.G. 2002. Effects of dietary methylmercury on reproduction of fathead minnows. Environmental Science and Technology 36:877-883.

Hatin, D, S. Lachance and D. Fournier. 2007. Effect of dredged sediment deposition on use by Atlantic sturgeon and lake sturgeon at an open-water disposal site in the St. Lawrence estuarine transition zone. Pages 235-256 in J. Munro, D. Hatin, J.E. Hightower, K. McKown, K.J. Sulak, A.W. Kahnle and F. Caron, editors. Anadromous sturgeons: habitats, threats and management. American Fisheries Society, Symposium 56, Bethesda, Maryland.

Henne, J.P. R.L. Crumpton, K.M. Ware, and J. Fleming. 2008. Guidelines for marking and tagging juvenile endangered shortnose sturgeon, *Acipenser brevirostrum*. Aquaculture America 2008, meeting abstract.

Hernandez-Divers S.J., Bakal R.S., Hickson B.H., Rawlings C.A., Wilson G.H., Radlinsky M., Hernandez-Divers S.M. and Dover S.R. 2004. Endoscopic sex determination and gonadal manipulation in Gulf of Mexico sturgeon (Acipenser oxyrinchus desotoi). Journal of Zoo & Wildlife Medicine, 35: 459-470. July 2004.

Herzog, D.P., V.A. Barko, J.S. Scheibe, R.A. Hrabik and D.E. Ostendorf. 2005, Efficacy of a benthic trawl for sampling small-bodied fishes in large river systems. North American Journal of Fisheries Management 25:594–603, 2005

Hill, J. 1996. Environmental Considerations in Licensing Hydropower Projects: Policies and Practices at the Federal Energy Regulatory Commission. American Fisheries Society Symposium 16: 190-199.

Jorgensen, E. H., O. Aas-Hansen, Al G. Maule, J. E. T. Strand, M. M. Vijayan. 2004. PCB impairs smoltification and seawater performance in anadromous Arctic char (*Salvelinus alpinus*). *Comparative Biochemsitry and Physiology*, Part C 138: 203-212.

Kahn J.A. and M.C. Mohead. 2010. A Protocol for Use of Shortnose, Atlantic, Gulf, and Green Sturgeons. U.S. Dept Commerce, NOAA Tech. Memo. NMFS-OPR-45, 62p. <http://www.nmfs.noaa.gov/pr/pdfs/species/kahn_mohead_2010.pdf>

Kieffer, M. and B. Kynard. *In Press*. Long-term evaluation of external and internal telemetry tagged shortnose sturgeon. Chapter 11 in Life history and behavior of Connecticut River shortnose sturgeon and other sturgeons. Special Publication 4, World Sturgeon Conservation Society.

Kjerfve, B. and J.E. Greer. 1978. Hydrography of the Santee river during moderate discharge conditions. Estuaries. 1(2):111-119.

Kynard, B. 1997. Life history, latitudinal patterns, and status of the shortnose sturgeon, *Acipenser brevirostrum. Environmental Biology of Fishes* 48: 319–334.

Kynard, B. 1998. Twenty-two years of passing shortnose sturgeon in fish lifts on the Connecticut River: What has been learned? Pages 255–264. In M. Jungwirth, S. Schmutz, and S. Weiss, editors. Fish migration and fish bypasses. Fishing News Books, London.

Lewis, J.A. 1996. Effects of underwater explosions on life in the sea. Autrailian Government, Defense, Science, and Technology Organization. http://dspace.dsto.defence.gov.au/dspace/.

Litwiler, T.L. 2001 Conservation plan for sea turtles, marine mammals, and the shortnose sturgeon in Maryland, Maryland Department of Natural Resources Technical Report FS-SCOL-01-2, Oxford, Maryland. 134 pp.

Longwell, A.C., S. Chang, A. Hebert, J. Hughes, and D. Perry. 1992. Pollution and developmental abnormalities of Atlantic fishes. *Environmental Biology of Fishes* 35:1-21.

Mac, M.J., and C.C. Edsall. 1991. Environmental contaminants and the reproductive success of lake trout in the Great Lakes: An epidemiological approach. *Journal of Toxicology and Environmental Health* 33:375-394.

Mangin, E. 1963. Croissance en Longueur de Trois Esturgeons d'Amerique du Nord: Acipenser oxyrhynchus, Mitchill, *Acipenser fulvescens*, Rafinesque, et *Acipenser brevirostrum* LeSueur. Verh. Int. Ver. *Limnology* 15: 968-974.

Marchette, D.E. and F. Smiley. 1982. Biology and life history of incidentally captured shortnose sturgeon, *Acipenser brevirostrum,* in South Carolina. S.C. Wild. Mar. Res. unpub. ms, 57 pp.

Matta, M.B., C. Cairncross, and R.M. Kocan. 1998. Possible Effects of Polychlorinated Biphenyls on Sex Determination in Rainbow Trout. *Environ. Toxicol. Chem. 17*:26-29.

McCabe, G. T., and L. G. Beckman. 1990. Use of an artificial substrate to collect white sturgeon eggs. California Fish and Game 76: 248-250.

McCord, J.W. 2003. Investigation of fisheries parameters for anadromous fishes in South Carolina. Completion Rep. to NMFS, Project No. AFC-53. SCDNR, Charleston, South Carolina. 145 pp.

McCord, J.W., M.R. Collins, W.C. Post, and T.I.J Smith. 2007. Attempts to develop a recruitment index for age-1 Atlantic sturgeon in South Carolina, USA. In: J. Munro, D. Hatin, K. McKown, J. Hightower, K. Sulak, A. Kahne, and F. Caron (editors). Proceedings of the Symposium on Anadromous Sturgeons: Status and Trends, Anthropogenic Impacts, and Essential Habitats.

McQuinn, I.H. and P. Nellis. 2007. An acoustic-trawl survey of middle St. Lawrence estuary demersal fishes to investigate the effects of dredged sediment disposal on Atlantic sturgeon and lake sturgeon distribution. Pages 257-272 in J. Munro, D. Hatin, J.E. Hightower, K. McKown, K.J. Sulak, A.W. Kahnle and F. Caron, editors. Anadromous sturgeons: habitats, threats and management. American Fisheries Society, Symposium 56, Bethesda, Maryland.

Mills, R. 1826. Statistics of South Carolina, including a view of the natural, civil, and military history, general and particular. Hurlbut and Lloyd. Charleston, South Carolina. pp. 348-777.

Moccia, R. D., E. J. Wilkie, K. R. Munkittrick, and W. D. Thompson. 1984. The use of fine needle fibre endoscopy in fish for in vivo examination of visceral organs, with special reference to ovarian evaluation. Aquaculture 40:255-259.

Moore A. and C. P. Waring. 2001. The effects of a synthetic pyrethroid pesticide on some aspects of reproduction in Atlantic salmon (*Salmo salar* L.). *Aquatic Toxicology* 52:1-12.

Moser, M.L. and S.W. Ross. 1995. Habitat use and movements of shortnose and Atlantic sturgeons in the Lower Cape Fear River, North Carolina. *Transactions of the American Fisheries Society* 124:225-234.

Moser, M.L. 1999. Cape Fear River Blast Mitigation Tests: Results of Caged Fish Necropsies. Final Report to CZR, Inc. under Contract to U.S. Army Corps of Engineers, Wilmington District.

Moser, M. L., M. Bain, M. R. Collins, N. Haley, B. Kynard, J. C. O'Herron II, G. Rogers and T. S. Squiers. 2000. A Protocol for use of shortnose and Atlantic sturgeons. U.S. Department of Commerce NOAA Technical Memorandum-NMFS-PR-18:18 pp.

Murray, M. J. 1998. Endoscopy in fish. Pages 59-75 in: M. J. Murray, B. Schildger, and M. Taylor (eds). Endoscopy in Birds, Reptiles, Amphibians, and Fish. Tuttlingen, Germany: Endo-Press.

NatureServe. 2005. NatureServe Explorer: An online encyclopedia of life [online web application]. Version 4.4. NatureServe, Arlington, Virginia. Accessed on May 30, 2005 at http://www.natureserve.org/explorer.

NJCOA. 2006. Monthly Highlights. New Jersey Division of Fish and Wildlife. Beureau of Law Enforcement, April 2006. http://www.njcoa.com/highlights/H_06_04.html.

Nellis, P., S. Senneville, J. Munro, G. Drapeau, D. Hatin, G. Desrosiers and F.J. Saucier. 2007. Tracking the dumping and bed load transport of dredged sediment in the St. Lawrence estuarine transition zone and assessing their impacts on macrobenthos in Atlantic sturgeon habitat. Pages 215-234 in J. Munro, D. Hatin, J.E. Hightower, K. McKown, K.J. Sulak, A.W. Kahnle and F. Caron, editors. Anadromous sturgeons: habitats, threats and management. American Fisheries Society, Symposium 56, Bethesda, Maryland.

Niklitschek, E. J. and D.H. Secor. 2005. Modeling spatial and temporal variation of suitable nursery habitats for Atlantic sturgeon in the Chesapeake Bay. Estuarine, Coastal and Shelf Science 64 135-148.

Niklitschek, E. J. 2001. Bioenergetics modeling and assessment of suitable habitat for juvenile Atlantic and shortnose sturgeons (*Acipenser oxyrinchus* and *A. brevirostrum*) in the Chesapeake Bay. Dissertation. University of Maryland at College Park, College Park.

NJCOA. 2006. Monthly Highlights. New Jersey Division of Fish and Wildlife. Beureau of Law Enforcement, April 2006. http://www.njcoa.com/highlights/H_06_04.html.

NMFS 1998. Final recovery plan for the shortnose sturgeon (*Acipenser brevirostrum*). Prepared by the Shortnose Sturgeon Recovery Team for the National Marine Fisheries Service, Silver Spring, Maryland. 104 pages.

O'Herron, II, J.C., Able, K.W. and R.W. Hastings. 1993. Movements of Shortnose Sturgeon (*Acipenser brevirostrum*) in the Delaware River. Estuaries 16: 235-240.

Ortenburger, A. I., M. E. Jansen, and S. K. Whyte. 1996. Nonsurgical video laparoscopy for determination of reproductive status of artic char. Canadian Veterinary Journal 37:96-100.

Parsley, M.J. and Beckman,L.G. 1994. White sturgeon spawning and rearing habitat in the Lower Columbia River. North American Journal of Fisheries Management 14:812-827.

Popper, A.N. 2005. A Review of Hearing by Sturgeon and Lamprey. Environmental BioAcoustics, LLC. Rockville, Maryland. Submitted to the U.S. Army Corps of Engineers, Portland District. August 12, 2005.

Quattro J.M., T.W. Greig, D.K. Coykendall, B.W. Bowen and J.D. Baldwin. 2002. Genetic issues in aquatic species management: the shortnose sturgeon (*Acipenser brevirostrum*) in the southeastern United States. Conservation Genetics. Vol 3: 155-166.

Richland, WA. Kocan, R. M., M. B. Matta, and S. Salazar. 1993. A laboratory evaluation of Connecticut River coal tar toxicity to shortnose sturgeon (*Acipenser brevirostrum*) embryos and larvae. Final Report, December 20, 1993. 23 pp.

Rosenthal, H. and D. F. Alderdice. 1976. Sublethal effects of environmental stressors, natural and pollutional, on marine fish eggs and larvae. *Journal of the Fisheries Research Board of Canada* 33: 2047-2065.

Ross, L.G. and B. Ross. 1999. Anaesthetic and sedative techniques for aquatic animals. Blackwell Science, Oxford, UK.

Ruelle, R., and C. Henry. 1992. Organochlorine Compounds in Pallid Sturgeon. Contaminant Information Bulletin, June, 1992.

Ruelle, R., and K.D. Keenlyne. 1993. Contaminants in Missouri River Pallid Sturgeon. *Bulletin of Environmental Contamination and Toxicology* 50:898-906.

Scholz N. L., N. K. Truelove, B. L. French, B. A. Berejikian, T. P. Quinn, E. Casillas and T. K. Collier. 2000. Diazinon disrupts antipredator and homing behaviors in Chinook salmon (*Oncorhynchus tshawytscha*). *Canadian J. of Fisheries and Aquatic Sciences* 57: 1911-1918.

Scott, W.B. and M.G. Scott. 1988. Atlantic fishes of Canada. *Canadian Bulletin of Fisheries and Aquatic Sciences* No. 219.

Secor, D. H. 1995. Chesapeake Bay Atlantic sturgeon: current status and future recovery. Summary of Findings and Recommendations from a Workshop convened 8 November 1994 at Chesapeake Biological Laboratory. Chesapeake Biological Laboratory, Center for Estuarine and Environmental Studies, University of Maryland System, Solomons, Maryland.

Secor, D.H. and T.E. Gunderson. 1998. Effects of hypoxia and temperature on survival, growth, and respiration of juvenile Atlantic sturgeon, Acipenser oxyrinchus. Fishery Bulletin 96: 603-613.

Secor, D. H. 2002. Atlantic sturgeon fisheries and stock abundances during the late nineteenth century. American Fisheries Society Sympos. 28: 89-98.

Secor, D.H. and E.J. Niklitschek. 2002. Sensitivity of sturgeons to environmental hypoxia: A review of physiological and ecological evidence, p. 61-78 In: R.V. Thurston (Ed.) Fish Physiology, Toxicology, and Water Quality. Proceedings of the Sixth International Symposium, La Paz, MX, 22-26 Jan. 2001. U.S. Environmental Protection Agency Office of Research and Development, Ecosystems Research Division, Athens, GA. EPA/600/R-02/097. 372 pp.

Smith, T.I.J., S.D. Lamprecht, and J.W. Hall. 1990. Evaluation of Tagging Techniques for Shortnose Sturgeon and Atlantic Sturgeon. American Fisheries Society Symposium 7:134-141.

Smith, T.I.J. and M.R. Collins. 1996. Shortnose sturgeon stocking success in the Savannah River. Proc. Ann. Conf. SE Assoc. Fish and Wildlife Agencies 50:112-121.

Smith, T. I. J. and J. P. Clugston. 1997. Status and management of Atlantic sturgeon, *Acipenser oxyrinchus*, in *North America. Environmental Biology of Fishes* 48:335-346.

Smith, T.I.J., J.W. McCord, M.R. Collins, and W.C. Post. 2002. Occurrence of stocked shortnose sturgeon Acipenser brevirostrum in non-target rivers. Journal of Applied Ichthyology 18(4-6): 470-474.

Stoskopf, M. K. 1993. Clinical examination and procedures. Pages 62-78 in: M. K. Stoskopf (ed). Fish Medicine. W. B. Saunders Co., Philadelphia, PA.

Summerfelt R.C. & Smith L.S. (1990) Anaesthesia, surgery and related techniques. In: Methods for Fish Biology . (eds. C.B. Schreck & P.B. Moyle), pp. 213-272.

U.S. Environmental Protection Agency (USEPA). 2003. Ambient water quality criteria for dissolved oxygen, water clarity and chlorophyll-a for the Chesapeake Bay and its tributaries. pp. 343, U.S. Environmental Protection Agency, Washington, DC (USA). http://www.epa.gov/Region3/chesapeake/baycriteria.htm

U.S. Environmental Protection Agency (USEPA). 2005. National Coastal Condition Report II. Washington, DC. EPA-620/R-03/002.

USFWS 2009. Species Reports. Environmental Conservation Online System. http://www.fws.gov/endangered/

USGS 2010. Nonindigenous Aquatic Species Database; Center for Aquatic Resource Studies. <http://nas.er.usgs.gov/>.

USACOE. 2008. Dredging. <http://www.nap.usace.army.mil/dredge/d2.htm>

Waring C. P. and A. Moore. 2004. The effect of atrazine on Atlantic salmon (*Salmo salar*) smolts in fresh water and after sea water transfer. *Aquatic Toxicology* 66:93-104.

Winger, P.V., P.J. Lasier, D.H. White, J.T. Seginak. 2000. Effects of contaminants in dredge material from the lower Savannah River. *Archives of Environmental Contamination and Toxicology* 38: 128-136.

Wydoski, R. and L. Emery. 1983. Tagging and marking. Pages 215-237 in: L.A. Nielson and D.L. Johnson (Eds.). *Fisheries Techniques*. American Fisheries Society, Bethesda, Maryland.

Appendix 1

Existing shortnose sturgeon research permits similar to the proposed action.			
Permit No.	**Location**	**Authorized Take**	**Research Activity**
10115 Expires: 8/3/2013	Saint Marys & Saltilla Rivers, FL & GA	85 adult/juv 20 ELS	Capture, handle, measure, weigh, PIT tag, tissue sample, collect ELS
14394 Expires: 9/30/14	Altamaha River and Estuary, GA	500 adult/juv. (1 lethal), 100 ELS	Capture, handle, weigh, measure, PIT tag, transmitter tag, tissue sample, anesthetize, laparoscopy, blood collection, fin ray section, collect ELS
10037 Expires: 4/30/2013	Ogeechee River and Estuary, GA	150 adult/juv. (2 lethal), 40 ELS	Capture, handle, measure, weigh, PIT tag, tissue sample, fin-ray section, anesthetize, laparoscopy, blood collection, radio tag, collect ELS
1447 Expires: 2/28/2012	S. Carolina Rivers and Estuaries	100 adult/juv. (2 lethal), 100 ELS	Capture, handle, measure, weigh, PIT and dart tag, transmitter tag, anesthetize, tissue sample, gastric lavage, collect ELS
1505-01* Expires: 5/15/2011	S. Carolina Rivers and Estuaries	98 adult/juv. (2 lethal), 200 ELS	Capture, handle, measure, weigh, PIT and dart tag, transmitter tag, anesthetize, laparoscopy, blood collection, tissue sample, gastric lavage, collect ELS
1542 Expires: 7/31/2011	Upper Santee River Basin, SC	5 adult/juv.; 100 ELS	Capture, handle, weigh, measure, PIT and dart tag, tissue sample, ELS collection
1543 Expires:11/30/2011	Upper Santee River Basin, SC	3 adult/juv.	Capture, handle, weigh, measure, tissue sample
14396 Expires: 12/31/2014	Delaware River and Estuary NJ & DE	100 adult/juv. (1 lethal),	Capture, handle, measure, weigh, dart tag, PIT tag, tissue sample, anesthetize, ultrasonic tag,
14604 Expires: 4/19/2015	Delaware River and Estuary NJ & DE	1,000 adult/juv (1 lethal) 500 ELS	Capture, handle, weigh, measure, PIT tag, dart tag, ultrasonic tag, tissue sample, anesthetize, laparoscopy, blood/biopsy collection, collect ELS
1547 Expires:10/31/2011	Hudson River, (Haverstraw & Newburgh), NY	500 adults/juv.	Capture, handle, weigh, measure, PIT & Carlin tag, tissue sample
1575 Expires11/30/2011	Hudson River (Tappan-Zee), NY	250 adult/juv.	Capture, handle, measure
1580 Expires: 3/31/2012	Hudson River and Estuary, NY	82 adult/juv.; 40 ELS	Capture, handle, measure, weigh, PIT tag, Carlin tag, photograph, tissue sample, collect ELS
1449 Expires: 3/31/2010	Upper Conn. River, MA	80 adult/juv.; 200 ELS	Capture, handle, measure, weigh, PIT tag, external radio tag, collect ELS
1549 -01 Expires: 1/31/2012	Upper Conn. River, MA	673 adult/juv (5 lethal), 1,430 ELS from East Coast rivers	Capture, handle, measure, weigh, anesthetize, PIT tag, TIRIS tag, radio tag, temperature/depth tag, tissue sample, borescope, laboratory tests, photographs, collect ELS
1516 Expires: 5/15/2011	Lower Conn. River & Estuary., CT	500 adult/juv (2 lethal); 300 ELS	Capture, handle, measure, weigh, PIT tag, sonic/radio tag, gastric lavage, fin ray section, collect ELS
1578-01 Expires: 11/30/2011	Kennebec River and Estuary, ME	500 adult/juv.; 30 ELS	Capture, handle, measure, weigh, tissue sample, PIT tag, acoustic tag, anesthetize, collect ELS
1595-04 Expires: 3/31/2012	Penobscot River and Estuary, ME	200 adult/juv. (2 lethal); 50 ELS	Capture, handle, measure, weigh, borescope, photograph, tissue sample, blood sample, Carlin tag, PIT tag, anesthetize, transmitter tag, collect ELS

*Permit currently requested to be replaced by File 15677.

Appendix 2

Table 1. Activities Proposed Under Permit No. 15677, annually.					
No.	Species	Life Stage	Take Activity	Location	Dates
20	shortnose sturgeon (*Acipenser brevirostrum*)	sub-adult, adult	Capture with gill & trammel nets, measure, weigh, photograph/video, dart tag, PIT tag, genetic tissue sample, anesthetize, sonic tag, recover, release	Savannah River	January - December
20	shortnose sturgeon (*Acipenser brevirostrum*)	sub-adult, adult	Capture with gill & trammel nets, measure, weigh, photograph/video, dart tag, PIT tag, genetic tissue sample, anesthetize, sonic tag, recover, release	Edisto River	January - December
24	shortnose sturgeon (*Acipenser brevirostrum*)	sub-adult, adult	Capture with gill & trammel nets, measure, weigh, photograph/video, dart tag, PIT tag, genetic tissue sample, anesthetize, laparoscopy, gonadal biopsy, blood sample, recover, release	Cooper River	January - December
10	shortnose sturgeon (*Acipenser brevirostrum*)	sub-adult, adult	Capture with gill & trammel nets, measure, weigh, photograph/video, dart tag, PIT tag, genetic tissue sample, anesthetize, sonic tag, recover, release	Cooper River	January - December
20	shortnose sturgeon (*Acipenser brevirostrum*)	sub-adult, adult	Capture with gill & trammel nets, measure, weigh, photograph/video, dart tag, PIT tag, genetic tissue sample, anesthetize, sonic tag, recover, release	Lake Marion & tributaries	January - December
20	shortnose sturgeon (*Acipenser brevirostrum*)	sub-adult, adult	Capture with gill & trammel nets, measure, weigh, photograph/video, dart tag, PIT tag, genetic tissue sample, anesthetize, sonic tag, recover, release	Santee River	January - December
20	shortnose sturgeon (*Acipenser brevirostrum*)	sub-adult, adult	Capture with gill & trammel nets, measure, weigh, photograph/video, dart tag, PIT tag, genetic tissue sample, anesthetize, sonic tag, recover, release	Winyah Bay System	January - December
20	shortnose sturgeon (*Acipenser brevirostrum*)	young of year & year-class 1	Capture with trawl, measure, weigh, photograph/ video, genetic tissue sample, recover, release	Lake Marion & tributaries, Edisto, Cooper Savannah, Santee, and Winyah Bay System	January - December
50	shortnose sturgeon (*Acipenser brevirostrum*)	eggs, larvae	lethal take with buffer pads	Savannah River	January - December
50	shortnose sturgeon (*Acipenser brevirostrum*)	eggs, larvae	lethal take with buffer pads	Lake Marion and tributaries	January - December

Appendix 3

Table 1. Species likely to be encountered as bycatch by proposed shortnose sturgeon gillnetting in South Carolina Rivers (SCDNR 2010)

Common Name	Scientific Name	Ranking
Alewife	*Alosa pseudoharengus*	0
American Eel	*Anguilla rostrata*	0
American Shad	*Alosa sapidissima*	8
Atlantic Menhaden	*Breevortia tyrannus*	8
Atlantic Needlefish	*Strongylura marina*	2
Atlantic Stingray	*Dasyatis sabina*	4
Atlantic Sturgeon	*Acipenser oxyrhynchus*	9
Black Crappie	*Pomoxis nigromaculatus*	0
Black Drum	*Pogonias cromis*	1
Blue Catfish	*Ictalurus furcatus*	9
Blue Crab	*Callinectes sapidus*	5
Blueback herring	*Alosa aestivalis*	5
Bluefish	*Pomatomus saltatrix*	1
Bowfin	*Amia calva*	2
Bullhead/Brown Catfish	*Ameiurus nebulosus*	1
Bullhead/Yellow Catfish	*Ameiurus natalis*	0
Chain pickerel	*Esox niger*	0
Channel Catfish	*Ictalurus punctatus*	2
Common Carp	*Cyprinus carpio*	3
Crevalle Jack	*Caranx hippos*	0
Ctenophoras	*Ctenophora sps.*	3
Flathead Catfish	*Pylodictis olivaris*	2
Gizzard Shad	*Dorosoma cepedianum*	2
Grass Carp	*Ctenopharyngodon idella*	3
Hickory Shad	*Alosa mediocris*	7
Jellyfish	*Cnidaria sps.*	3
Largemouth Bass	*Micropterus salmoides*	0
Longnose Gar	*Lepisosteus osseus*	10
Mud Crabs	*Xanthidae sps.*	0
Painted Turtle	*Chrysemys picta*	0
Red Drum	*Sciaenopps ocellatus*	2
Redear Sunfish	*Lepomis microlophus*	1
Sea Lamprey	*Petromyzon marinus*	2
Snapping Turtle	*Chelydra serpentina*	0
Southern Flounder	*Paralychthys lethostigma*	1
Spotted Seatrout	*Cynoscion nebulosus*	1
Striped Bass	*Morone saxatilis*	2

Striped Mullet	*Mugil cephalus*	1
Striped x White Bass	*M. saxatilis x chrysops*	0
Suckers	*Moxostoma sps.*	1
Summer Flounder	*Paralychthys dentatus*	1
Weakfish Seatrout	*Cynoscion regalis*	0
White Catfish	*Ameiurus catus*	5
White Mullet	*Mugil curema*	0
White Perch	*Morone americana*	0
Yellow Perch	*Perca flavescens*	0

Appendix 4:

Florida Manatee Sighting Report

Sighting Information

Date of Sighting:______________________ Time of Sighting:_______________________

Number of Manatee:___________________ Number of Calves (<4 ft):________________

Direction of Travel (check one): North South East West Stationary Unknown

Location (detailed description):

____

Location Coordinates (decimal degrees):__________________N ___________________W

Photos Taken: Yes No Type: Digital Prints Slides Video

Comments (behavior, was animal tagged, etc.; additional space on back):

____

Contact Information

Date of Report: _________________ Name:_____________________________________

Address or Affiliation:____

Telephone:_________________________Email:___________________________________

To Report any Gear or Vessel Interactions, or Sightings of Manatee – Contact: Nicole Adimey (USFWS) at 904-731-3079 (weekdays); 904-655-0730 (cell); and 904-731-3045 (fax).

Report Dead or Injured Manatees Immediately – Contact: South Carolina Marine Mammal Stranding Program 800-922-5431.

MAY 26 2011

FINDING OF NO SIGNIFICANT IMPACT

ON THE EFFECTS OF THE ISSUANCE OF A SCIENTIFIC RESEARCH PERMIT (NO. 15677) TO CONDUCT SCIENTIFIC RESEARCH ON SHORTNOSE STURGEON IN SOUTH CAROLINA RIVERS.

National Marine Fisheries Service

On September 3, 2010, the National Marine Fisheries Service, Office of Protected Resources (NMFS PR) received a new scientific research permit application from the South Carolina Division of Natural Resources (William Post, Principal Investigator) to conduct shortnose sturgeon research in South Carolina coastal rivers.

In accordance with the National Environmental Policy Act (NEPA), NMFS prepared an Environmental Assessment (EA) analyzing the impacts on the human environment associated with issuing the permit (*Environmental Assessment on the Effects of the Issuance of a Scientific Research Permit (File 15677) to Conduct Research on Shortnose Sturgeon in South Carolina Rivers*). In addition, a Biological Opinion was issued under Section 7 of the Endangered Species Act (ESA) (*Biological Opinion on the Permits, Conservation and Education Division's proposal to issue a Scientific Research Permit (Number 15677) to the South Carolina Division of Natural Resources (William Post, Responsible Party) for research on shortnose sturgeon in South Carolina rivers pursuant to section 10(a)(1)(A) of the Endangered Species Act of 1973.)* The analyses in the EA, as informed by the Biological Opinion, support the following findings and determination.

The National Oceanic and Atmospheric Administration's Administrative Order 216-6 (May 20, 1999) for implementing NEPA, contains criteria for determining the significance of the impacts of a proposed action. In addition, the Council on Environmental Quality (CEQ) NEPA implementing regulations at 40 C.F.R. 1508.27 state the significance of an action should be analyzed both in terms of "context" and "intensity." Each criterion listed below is relevant to making a finding of no significant impact and has been considered individually, as well as in combination with the others. The significance of this action is analyzed based on the NAO 216-6 criteria and CEQ's context and intensity criteria. These include:

(1) Can the proposed action reasonably be expected to cause substantial damage to the ocean and coastal habitats and/or essential fish habitat (EFH) as defined under the Magnuson - Stevens Act and identified in Fishery Management Plans?

Response: The proposed research activities include boating and netting activity taking place in South Carolina coastal rivers and upper estuaries. However, no coral reef, seagrass beds and other sensitive ecosystems occur in the action areas of the proposed activities, and thus none would be affected. However, designated EFH does exist for federally managed species in South Carolina rivers within the action area. Specifically, coinciding with the proposed research activities of gill netting, trawling and boating activities, the tidally mixed areas have designated EFH that could be impacted.

However, with respect to the proposed research activities, NMFS PR concluded minimal potential impacts to EFH of managed species would be caused by the proposed boating, gill netting and trawling activities. Further, because prey of managed species, potentially captured as by-catch in gill nets, would be returned unharmed, no indirect impacts are anticipated.

NMFS PR contacted the Southeast Regional Office of Habitat Conservation (Beaufort Lab, Beaufort, NC) by email on January 3, 2011 asking for concurrence that the permitted activities would not impact EFH for other managed species in the action area. The Office agreed with NMFS PR on January 4, 2011 (by email from Fritz Rhode) that the proposed use of anchored and drift gill nets and trawls to capture shortnose sturgeon in South Carolina rivers would have minimal impacts on designated Essential Fish Habitat in these areas. Thus no further consultation was necessary.

(2) Can the proposed action be expected to have a substantial impact on biodiversity and/or ecosystem function within the affected area (e.g., benthic productivity, predator-prey relationships, etc.)?

Response: No substantial impacts on biodiversity or ecosystem function within the affected action areas are expected. The bottom substrate of the proposed areas for sampling consists of sandy loam sediment, mud flats and some rocky substrate in the upper branches of rivers. Thus, the impacts to bottom substrate would typically be during capture; however, due to the minimal contact by nets in localized areas— in addition to the proposed mitigation measures set forth in the permit for trawling with balloon trawls—NMFS expects minimal disturbance of the benthic organisms and substrate.

Due to the nature of netting, NMFS would expect some other non-targeted species would become enmeshed. However, non-target fish would be removed from the net and released at the site of capture at short intervals, and it is believed that virtually all by-catch would be released alive without long-term effects on predator-prey relationships. It is also expected some sub-adult and adult Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*) would be taken during sampling for shortnose sturgeon. Atlantic sturgeon is currently a candidate species proposed for listing under NMFS jurisdiction, co-occurring with shortnose sturgeon in the action areas described. A proposed rule for listing Atlantic sturgeon was published on October 4, 2010; however, the species does not receive protections under the ESA until a final rule becomes effective. Consequently, should a listing of Atlantic sturgeon occur coinciding with the applicants' research activities, the effects on Atlantic sturgeon would be analyzed at that time. In the interim, the researcher would monitor gill nets closely, and if an Atlantic sturgeon is captured, NMFS would request in the permit that similar netting protocols and standard research conditions for shortnose sturgeon be used for ensuring Atlantic sturgeon survival.

(3) Can the proposed action reasonably be expected to have a substantial adverse impact on public health or safety?

Response: Issuance of the permit modifications is not expected to have substantial adverse impacts on public health or safety. These actions would involve the use of 95% ethanol pre-measured in vials for preservation, storage, and transportation of tissue samples. MS-222 powder, used for anesthetizing shortnose sturgeon during surgery, would also be transported in premeasured amounts and mixed onboard. Researchers would handle these chemicals safely and be advised in the permit to dispose of the chemicals safely following state approved measures.

(4) Can the proposed action reasonably be expected to adversely affect endangered or threatened species, their critical habitat, marine mammals, or other non-target species?

Response: The proposed research activities could potentially have adverse effects on individual endangered shortnose sturgeon, but the effects are not expected to be significant, and have not been shown to be significant at the population or species level. Further, the permit activities require standard NMFS research and mitigation protocols to minimize stress and harmful effects on the species. No incidental mortalities are authorized or anticipated in the permitted activities. In the Biological Opinion produced for this action, NMFS concluded issuance of the permit would not likely jeopardize the continued existence of the endangered shortnose sturgeon.

Likewise, NMFS believes any by-catch encountered in both of the studies would be returned immediately to the water with minimal exposure to handling stress. That is, because nets would typically be checked at short intervals, NMFS considers virtually all by-catch would be released alive. Atlantic sturgeon is considered a NMFS "species of concern" occurring in action area in small numbers; hence, there is potential for Atlantic sturgeon to be captured as by-catch. Accordingly, the researchers would monitor nets closely and if this sturgeon species is captured, appropriate measures would be taken to ensure its survival. Also, in the event a protected marine mammal or other protected non-target species is encountered while boating or netting, researchers would be directed by permit conditions to avoid contact with the animals, and would also be advised on how to protect these animals if captured.

Critical habitat has yet to be designated for shortnose sturgeon; thus, none would be affected. Likewise, there is none specified for other listed animals in the action area.

(5) Are significant social or economic impacts interrelated with natural or physical environmental effects?

Response: There are no known social or economic impacts associated with the proposed actions. Therefore, there would be no significant social or economic impacts interrelated with natural or physical environmental effects.

(6) Are the effects on the quality of the human environment likely to be highly controversial?

Response: A *Federal Register* notice (75 FR 74003) was published on November 30, 2010, allowing other agencies and the public to comment on the action. No comments from the public were received on the application. All agency comments were appropriately addressed within the scoping summary of the EA and responses were included in the decision memos for the permits. None of the comments were controversial and none addressed the proposal's potential effects on the quality of the human environment.

(7) Can the proposed action reasonably be expected to result in substantial impacts to unique areas, such as historic or cultural resources, park land, prime farmlands, wetlands, wild and scenic rivers, essential fish habitat, or ecologically critical areas?

Response: The research methods in the proposed permits have been analyzed under the current EA, and the activities would not be expected to result in significant impacts to any unique areas mentioned above. Parts of three National Wildlife Refuges (NWR) operated by the US Fish and Wildlife Service (USFWS) are transected by river systems within the action area of the proposed research. These are the Savannah River NWR, located upstream from the City of Savannah, GA; the Waccamaw NWR, located near Georgetown, SC; and the ACE Basin NWR, located near Hollywood, SC. Each refuge is characterized by bottomland hardwoods and tidal freshwater marshes and many impoundments managed for migratory wading birds and waterfowl. They are also home to a large variety of wildlife including ducks, geese, wading birds, shorebirds and several endangered and/or threatened species including, wood storks, manatees and the target species, shortnose sturgeon.

The USFWS has cooperative agreements with South Carolina, and each refuge actively supports scientific research on protected species within its boundaries. Because of the limited boating and netting activities in aquatic habitats proposed by researchers, NMFS considers it would have limited environmental impact when in rivers crossing the refuge. Further, researchers are well aware of the potential of interacting with ESA listed animals in these areas and follow prescribed means for avoiding interaction or disturbing listed animals.

Additionally, with respect to anticipated effects on EFH by gill nets and boating activities, NMFS concluded these would result in minimal disturbance to the physical environment, including the bottom substrate and any portion having EFH.

(8) Are the effects on the human environment likely to be highly uncertain or involve unique or unknown risks?

Response: Potential risks by proposed research methods are not unique or unknown, nor is there significant uncertainty about impacts. Monitoring reports from other permits of similar nature, and published scientific information on impacts of research on shortnose sturgeon, indicate the proposed activities would not result in significant adverse impacts to the human environment or the species. There is also considerable scientific information available on the minimal likelihood of such impacts.

(9) Is the proposed action related to other actions with individually insignificant, but cumulatively significant impacts?

Response: There are three other shortnose sturgeon permits authorized in South Carolina waters, one with similar objectives and an action area overlapping the proposed action. However, overall, each of the actions, including the proposed action, would be expected to have no more than short-term effects on individual endangered shortnose sturgeon and no effects on other aspects of the environment. The incremental impacts of the actions when added to other past, present, and reasonably foreseeable future actions discussed in the environmental assessment would be minimal and not significant.

(10) Is the proposed action likely to adversely affect districts, sites, highways, structures, or objects listed in or eligible for listing in the National Register of Historic Places or may cause loss or destruction of significant scientific, cultural or historical resources?

Response: The action would not take place in any district, site, highway, structure, or object listed in or eligible for listing in the National Register of Historic Places; thus, none would be impacted. The proposed action would also not occur in an area of significant scientific, cultural or historical resources and would not cause their loss or destruction.

(11) Can the proposed action reasonably be expected to result in the introduction or spread of a non-indigenous species?

Response: The U.S. Geological Survey (USGS) has documented several aquatic nuisance species occurring in the proposed research area having potential to be spread by research into adjacent watersheds. However, the researcher has agreed to follow certain conditions proposed by NMFS (outlined in the accompanying EA) minimizing the potential spread of these aquatic nuisance species. Therefore, the proposed research activities would not be expected to result in introduction or spread of non-indigenous species to other watersheds. The research activities would also not involve discharging bilge water or other issues of concern relative to non-indigenous species.

(12) Is the proposed action likely to establish a precedent for future actions with significant effects or represent a decision in principle about a future consideration?

Response: The decision to issue this research permit would not be precedent setting nor would it affect any future decisions. NMFS has issued numerous scientific research permits to study shortnose sturgeon pursuant to section 10 of the Endangered Species Act; thus, this is not the first permit NMFS has issued for this type of research activity. Issuance of a permit or permit modification, to a specific individual or organization for a given research activity, does not in any way guarantee or imply NMFS would authorize other individuals or organizations to conduct the same research activity. Any future request received, including those by the applicants, would be evaluated upon its own merits relative to the criteria established in the ESA and NMFS' implementing regulations.

(13) Can the proposed action reasonably be expected to threaten a violation of Federal, State, or local law or requirements imposed for the protection of the environment?

Response: Issuance of the proposed permit is not expected to violate any Federal, State, or local laws for environmental protection. NMFS has sole jurisdiction for issuance of such permits for shortnose sturgeon and has determined the proposed research activities are consistent with applicable provisions of the ESA. The permit contains language stating the permit does not relieve the Permit Holder of the responsibility to obtain other permits, or comply with other Federal, State, local, or international laws or regulations.

(14) Can the proposed action reasonably be expected to result in cumulative adverse effects having a substantial effect on the target species or non-target species?

Response: NMFS concluded the proposed procedures would have potential adverse effects on individual shortnose sturgeon. However, because shortnose sturgeon are a robust species and respond well to the types of handling proposed, the cumulative effects on the population are not likely long-term or significant to the species.

Because a new proposed listing was published for the Atlantic sturgeon on October 4, 2010, NMFS PR considered the future potential for cumulative effects on Atlantic sturgeon as by-catch in these studies. Accordingly, NMFS established in the permits provisions for monitoring interactions with Atlantic sturgeon, placing conditions in the permit detailing procedures to be used if an Atlantic sturgeon is incidentally captured. In particular, permits are conditioned stating Atlantic sturgeon should be handled with similar protocols protective for shortnose sturgeon, as well as requesting Atlantic sturgeon are minimally PIT and Floy tagged and also genetically sampled. NMFS concludes since researchers would be monitoring their nets closely, if Atlantic sturgeon or other by-catch were captured, appropriate measures would be in place to ensure survival.

Likewise, NMFS considered potential impacts from marine mammal interactions with researchers when sampling for sturgeon. Although interactions would be extremely rare based on historical records, sampling methods used to minimize contact would nevertheless be conditioned in permits to minimize any adverse effects of boating and netting activities of researchers.

DETERMINATION

In view of the information presented in this document and the analyses contained in the EA prepared for issuance of the permit, pursuant to the ESA, and the ESA section 7 Biological Opinion, it is hereby determined that the issuance of Permit No. 15677 would not significantly impact the quality of the human environment as described above. In addition, all beneficial and adverse impacts of the proposed action have been addressed reaching the conclusion of no significant impacts. Accordingly, preparation of an Environment Impact Statement (EIS) for this action is not necessary.

James H. Lecky
Director, Office of Protected Resources

May 26, 2011
Date